AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE	OF	PAGES
	1		3

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0001	1 AUGUST 2000		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
US ARMY ENGINEER DISTRICT, FORT WORTH ATTN: CESWF-CT (RM 2A19) PO BOX 17300 FORT WORTH, TX 76102-0300			

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*	(X)	9A. AMENDMENT OF SOLICIATION NO.
	☒	DACA63-00-B-0026
		9B. DATED *(SEE ITEM 11)* 13 JULY 2000
	☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
		10B. DATED *(SEE ITEM 11)*
CODE / FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☒ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:

(a)By completing items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (*Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

The Solicitation for WEST CONTROL TOWER, RANDOLPH AIR FORCE BASE, SAN ANTONIO, TEXAS, is amended as follows:

See Continuation Sheet.

NOTE: The Bid Opening Date and time remains "15 AUGUST 2000, AT 2 P.M. LOCAL TIME," as previously announced.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
15B. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*	16C. DATE SIGNED

Item 14. Continued.

a. Drawings

The drawings listed below shall be voided and the accompanying revised drawings of the same number, each bearing the notation "AM #0001", shall be substituted therefor:

C13_01.cal	Seq 5	C1.3	SITE LAYOUT PLAN
C14_01.cal	Seq 6	C1.4	SITE GRADING AND DRAINAGE PLAN
C16_01.cal	Seq 8	C1.6	SANITARY SEWER PLAN AND PROFILE
C21_01.cal	Seq 9	C2.1	SITE DETAILS
C22_01.cal	Seq 10	C2.2	SITE DETAILS
C23_01.cal	Seq 11	C2.3	SITE DETAILS
C24_01.cal	Seq 12	C2.4	SITE DETAILS
A14_01.cal	Seq 17	A1.4	FLOOR PLAN LEVELS SIX AND SEVEN
A15_01.cal	Seq 18	A1.5	FLOOR PLAN LEVEL EIGHT AND ROOF PLAN
A16_01.cal	Seq 19	A1.6	REFLECTED CEILING PLAN GROUND LEVEL
A18_01.cal	Seq 21	A1.8	REFLECTED CEILING PLAN LEVELS FOUR AND FIVE
A19_01.cal	Seq 22	A1.9	REFLECTED CEILING PLAN LEVELS SIX AND EIGHT
A22_01.cal	Seq 28	A2.2	DOOR AND WINDOW SCHEDULE
A31_01.cal	Seq 29	A3.1	ELEVATIONS
A32_01.cal	Seq 30	A3.2	ELEVATIONS
A51_01.cal	Seq 33	A5.1	EXTERIOR DETAILS
A53_01.cal	Seq 35	A5.3	EXTERIOR DETAILS
A57_01.cal	Seq 39	A5.7	EXTERIOR DETAILS
A58_01.cal	Seq 40	A5.8	EXTERIOR DETAILS
A59_01.cal	Seq 41	A5.9	EXTERIOR DETAILS
A510_01.cal	Seq 42	A5.10	EXTERIOR DETAILS
A62_01.cal	Seq 45	A6.2	INTERIOR DETAILS - ENLARGED CAB CONSOLE PLAN
A614_01.cal	Seq 57	A6.14	INTERIOR DETAILS
S11_01.cal	Seq 58	S1.1	STRUCTURAL GENERAL NOTES AND QUALITY CONTROL
S21_01.cal	Seq 59	S2.1	GROUND LEVEL FOUNDATION AND SLAB PLANS
S31_01.cal	Seq 60	S3.1	LEVELS TWO AND THREE FLOOR FRAMING PLANS
S32_01.cal	Seq 61	S3.2	LEVELS FOUR AND FIVE FLOOR FRAMNG PLANS
S33_01.cal	Seq 62	S3.3	LEVELS SIX AND SEVEN FLOOR FRAMING PLANS
S34_01.cal	Seq 63	S3.4	LEVEL EIGHT FLOOR AND ROOF FRAMING PLANS
S41_01.cal	Seq 64	S4.1	STRUCTURAL BUILDING SECTION
S51_01.cal	Seq 65	S5.1	FOUNDATION DETAILS
S52_01.cal	Seq 66	S5.2	FOUNDATION DETAILS
S61_01.cal	Seq 67	S6.1	PRECAST CONCRETE FRAMING DETAILS
S62_01.cal	Seq 68	S6.2	PRECAST CONCRETE FRAMING DETAILS
S63_01.cal	Seq 69	S6.3	PRECAST CONCRETE FRAMING DETAILS
S64_01.cal	Seq 70	S6.4	PRECAST CONCRETE FRAMING DETAILS
S65_01.cal	Seq 71	S6.5	PRECAST CONCRETE FRAMING DETAILS
S71_01.cal	Seq 72	S7.1	ROOF FRAIMING DETAILS
S72_01.cal	Seq 73	S7.2	ROOF FRAIMING DETAILS
S81_01.cal	Seq 74	S8.1	STAIR FRAMING DETAILS
S82_01.cal	Seq 75	S8.2	STAIR FRAMING DETAILS
S101_01.cal	Seq 77	S10.1	MASONRY WALL DETAILS
S102_01.cal	Seq 78	S10.2	MASONRY WALL DETAILS
M21_01.cal	Seq 85	M2.1	HVAC DETAILS
M23_01.cal	Seq 87	M2.3	HAVC DETAILS
M31_01.cal	Seq 89	M3.1	HVAC CONTROLS
M32_01.cal	Seq 90	M3.2	HVAC CONTROLS
M41_01.cal	Seq 91	M4.1	HVAC SCHEDULES
P15_01.cal	Seq 97	P1.5	PLUMBING PLAN CAB AND ROOF

P21_01.cal	Seq 98	P2.1	PLUMBING RISERS
P31_01.cal	Seq 99	P3.1	PLUMBING DETAILS AND SCHEDULES
E11_01.cal	Seq 100	E1.1	ELECTRICAL SYMBOLS AND LIGHT FIXTURE SCHEDULE
E12_01.cal	Seq 101	E1.2	ELECTRICAL SINGLE LINE DIAGRAM
E21_01.cal	Seq 102	E2.1	LIGHTING PLAN GROUND LEVEL
E22_01.cal	Seq 103	E2.2	LIGHTING PLANS LEVELS TWO AND THREE
E23_01.cal	Seq 104	E2.3	LIGHTING PLANS LEVELS FOUR AND IFVE
E24_01.cal	Seq 105	E2.4	LIGHTING PLANS LEVELS SIX AND CATWALK
E26_01.cal	Seq 107	E2.6	POWER PLAN GROUND LEVEL
E210_01.cal	Seq 111	E2.10	POWER PLANS CAB AND ROOF
E32_01.cal	Seq 113	E3.2	ELECTRICAL DETAILS INTERIOR
E37_01.cal	Seq 118	E3.7	ELECTRICAL DETAILS EXTERIOR
E38_01.cal	Seq 119	E3.8	ELECTRICAL DETAILS EXTERIOR
E41_01.cal	Seq 120	E4.1	ELECTRICAL PANEL BOARD SCHEDULES
E42_01.cal	Seq 121	E4.2	ELECTRICAL PANELBOARD SCHEDULES
ES11_01.cal	Seq 122	ES1.1	ELECTRICAL SITE PLAN
ES12_01.cal	Seq 123	ES1.2	SITE COMMUNICATIONS PLAN

b. Specifications

Revised sections have deletions indicated by [AM#0001] and blank line and additions by underlined text. The sections listed below shall be voided and the accompanying revised sections of the same title and number, each bearing the notation "ACCOMPANYING AMENDMENT NO. 0001 TO SOLICITATION NUMBER: DACA63-00-B-0026" shall be substituted therefor:

01000 CONSTRUCTION SCHEDULE
01320 PROJECT SCHEDULE
02220 DEMOLITION
03201 STEEL BARS AND WELDED WIRE FABRIC FOR CONCRETE REINFORCEMENT
05400 COLD-FORMED STEEL FRAMING
07551 MODIFIED BITUMEN ROOFING
08700 BUILDERS' HARDWARE
14240 ELEVATORS, HYDRAULIC
16263 DIESEL-GENERATOR SET STATIONARY 100-2500 KW, WITH AUXILIARIES
16710 PREMISES DISTRIBUTION SYSTEM

-- End of Document --

SECTION 01000

CONSTRUCTION SCHEDULE
01/2000
AMENDMENT 0001

PART 1 GENERAL

1.1 SCHEDULE

Commence, prosecute, and complete the work under this contract in accordance with the following schedule and Section 00800 SPECIAL CONTRACT REQUIREMENT clauses COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK and LIQUIDATED DAMAGES:

Item of Work	Commencement of Work (calendar days)	Completion of Work (calendar days)	Liquidated Damages per calendar day
(1) All Work	Within 10 days after receipt of Notice to Proceed	**[AM#0001]** **480**	$ 680.00
(2) Establishment of Turf	*	*	---
(3) Landscaping	**	**	---

*Establishment of Turf

Planting and maintenance for turfing shall be in accordance with Section 02933 ESTABLISHMENT OF TURF . No payment will be made for establishment of turf until all requirements of the section are adequately performed and accepted, as determined by the Contracting Officer.

**Landscaping

Planting and maintenance for landscaping shall be in accordance with Section 02962 PLANTING OF TREES, SHRUBS, AND VINES . No payment will be made for landscaping until all requirements of the section are adequately performed and accepted, as determined by the Contracting Officer.

1.1.1 Testing of Heating and Air-Conditioning Systems

The times stated for completion of this project includes all required testing specified in appropriate specification sections of heating, air conditioning and ventilation systems including HVAC Commissioning. Exception: boiler combustion efficiency test, boiler full load tests, cooling tower performance tests, and refrigeration equipment full load tests, when specified in the applicable specifications, shall be preformed in the appropriate heating/cooling season as determined by the Contracting Officer.

1.2 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER (OCT 1989)
(ER 415-1-15)(52.0001-4038 1/96)

a. This provision specifies the procedure for determination of time extensions for unusually severe weather in accordance with the contract clause entitled "Default: (Fixed Price Construction)." In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

(1) The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

(2) The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the contractor.

b. The following schedule of monthly anticipated adverse weather delays due to precipitation and temperature is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities. Wind is not considered in the Monthly Anticipated Adverse Weather Calendar Day Schedule.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY
WORK DAYS BASED ON (5) DAY WORK WEEK

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
4	3	3	2	4	4	1	1	3	2	2	3

c. Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the contractor's scheduled work day.

The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph "b", above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the contract clause entitled "Default (Fixed Price Construction)."

1.3 WORK RESTRICTIONS

1.3.1 Working Hours

The normal duty working shift shall be Monday through Thursday, 7:30 a.m. - 4:30 p.m.

1.3.2 Access

The Access to the Base is "USAF Controlled Access".

1.3.3 Security

Construction area is adjacent to airfield flightline which is restricted. Contractor personnel will not have access to the flightline.

1.3.4 Control of Debris/Dust

Contractor shall implement measures to control debris and excessive dust from blowing onto flightline or surrounding area. Submit proposal to the Contracting Officer for approval at the preconstruction conference.

Contractor shall perform cleanup during work to ensure foreign objects are not introduced to the aircraft parking and taxi areas. Construction debris which could become airborne shall be cleaned up immediately. Continuously clean up the work area of any loose or unnecessary construction materials or equipment at the end of each working day. After completion of project and satisfactory conformance to all specifications, clean up all debris and surplus materials resulting from the work and remove it from Randolph AFB at Contractor's own expense.

1.3.5 Salvage

Salvage items are identified on the drawings and in Section 02220.

1.4 UTILITIES

1.4.1 Payment for Utility Services (FAR 36.303(C)(6))

Water, gas, and electricity are available from Government-owned and operated systems and will be charged to the Contractor at rates as provided in Contract Clause 52.236.14 AVAILABILITY AND USE OF UTILITY SERVICES.

1.4.1.1 Meters and Temporary Connections

The Contractor, at its expense and in a manner satisfactory to the Contracting Officer, shall provide and maintain necessary temporary connections, distribution lines, and meter bases (Government will provide meters) required to measure the amount of each utility used for the purpose of determining charges. The Contractor shall notify the Contracting Officer, in writing, 5 working days before final electrical connection is desired so that a utilities contract can be established. The Government will provide a meter and make the final hot connection after inspection and approval of the Contractor's temporary wiring installation. The Contractor shall not make the final electrical connection.

1.4.1.2 Advance Deposit

An advance deposit for utilities consisting of an estimated month's usage or a minimum of $50.00 will be required. The last monthly bills for the fiscal year will normally be offset by the deposit and adjustments will be billed or returned as appropriate. Services to be rendered for the next fiscal year, beginning 1 October, will require a new deposit. Notification of the due date for this deposit will be mailed to the Contractor prior to the end of the current fiscal year.

1.4.1.3 Final Meter Reading

Before completion of the work and final acceptance of the work by the Government, the Contractor shall notify the Contracting Officer, in writing, 5 working days before termination is desired. The Government will take a final meter reading, disconnect service, and remove the meters. The Contractor shall then remove all the temporary distribution lines, meter bases, and associated paraphernalia. The Contractor shall pay all outstanding utility bills before final acceptance of the work by the Government.

1.4.2 Outages

The Contractor shall coordinate all requests for utility outages with the Contracting Officer in writing 14 days prior to date of requested outage:

a. Water, gas, steam, and sewer outages shall be held to a maximum duration of 4 hours unless otherwise approved in writing.

b. Electrical outages shall have a maximum duration of 4 hours.

1.5 STREET CLOSINGS

The Contractor shall coordinate all requests for street closings with the Contracting Officer in writing 14 days prior to date of requested outage:

a. One lane traffic shall be maintained at all times (except that a total closing may be allowed for specific 8-hour periods).

b. The final street repair shall be completed within 14 days after the start of any street crossing. Any part of the street returned to service prior to final repair shall be maintained smooth with hot-mix cold-lay surface course.

1.6 CONTRACTOR'S CONSTRUCTION SITE LIMITS

The contractor's construction site shall be limited to the areas indicated on Sheet C1.2. All work within these areas shall be coordinated with the Contracting Officer.

a. Contractor shall provide FOD fence around defined construction site to maintain cleanliness of construction area.

1.7 CONSTRUCTION CRANE LIMITATIONS

The contractor shall notify the Contracting Officer 14 days in advance of

mobilization or erection of a crane on the site. Use of cranes is allowed on this project, but cranes are not allowed out of the Contractor's Construction Site Limits. The crane is required to have obstruction lighting which shall be illuminated at night and at any time requested by the Contracting Officer.

1.8 WELDING AND OPEN FLAME

Welding, cutting and any other operation requiring sparks or open flame shall not be conducted without a permit, issued by Randolph AFB Fire Department, telephone number (210) 652-4616. Contractor shall obtain written approval from Contracting Officer no less than five working days prior to start of work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

SECTION 01320

PROJECT SCHEDULE
6/97
AMENDMENT 0001

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referenced in the text by basic designation only.

ENGINEERING REGULATIONS (ER)

ER 1-1-11	(1995) Progress, Schedules, and Network Analysis Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Schedules

Preliminary Project Schedule; FIO.

Initial Project Schedule; GA.

Periodic Schedule Updates; GA.

Three copies of the schedules, in hard copy and on data disk(s), showing codes, values, categories, numbers, items, etc., as required.

SD-08 Statements

Qualifications Of Scheduler; FIO.

Documentation showing qualifications of personnel preparing schedule reports.

SD-09 Reports

Narrative Report; FIO.

Schedule Reports; FIO.

Three copies of the reports, in hard copy and on data disk(s), showing numbers, descriptions, dates, float, starts, finishes, durations, sequences, etc., as required.

1.3 QUALIFICATIONS OF SCHEDULER

The Contractor shall designate a scheduler who shall be responsible for the preparation of the project schedule and periodic updates. The scheduler shall have previous experience in creating and reviewing computerized schedules. The scheduler shall have the responsibility of updating and coordinating the schedule in a timely manner. Qualifications of this individual shall be submitted to the Contracting Officer for review with the Preliminary Project Schedule submission.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

Pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS, a Project Schedule as described below shall be prepared. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project should also contribute in developing and maintaining an accurate and current Project Schedule. The approved Project Schedule shall be used to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis for all progress payments.

3.2 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below. A data disk and a printed, legible network diagram are required for each submission. Submissions shall contain the same level of detail as is being used by the contractor for project management.

3.2.1 Preliminary Project Schedule Submission

The Preliminary Project Schedule, defining the contractor's planned operations for the first 90 calendar days shall be submitted within 15 calendar days after Notice to Proceed is acknowledged unless otherwise approved by the Contracting officer. Summary activities for the remainder of the project will be included along with budgeted costs for all activities. The sum of the budgeted costs shall equal the contract amount. This schedule, upon acceptance, will be used for payment purposes not to exceed 90 calendar days after Notice to Proceed. After that time period, the approved, updated Initial Schedule shall be used.

3.2.2 Initial Project Schedule Submission

The Initial Project Schedule shall be submitted for approval within 45 calendar days after Notice to Proceed is acknowledged unless otherwise approved by the Contracting Officer. This schedule shall provide a logical sequence of activities which represent work activities throughout the entire project and shall be at a level of detail appropriate as defined in paragraph PROJECT SCHEDULE. The Government has 30 days for approval.

3.2.3 Periodic Schedule Updates

Based on an evaluation of actual job progress during meetings specified in paragraph PERIODIC PROGRESS MEETINGS, the Contractor shall submit Periodic Schedule Updates. These periodic updates shall enable the Contracting Officer to assess the Contractor's progress. If the contractor fails or refuses to furnish the information and project schedule data which, in the judgement of the Contracting Officer or authorized representative, is necessary for verifying the contractor's progress, the contractor shall be deemed not to have provided an estimate upon which progress payments may be made.

3.3 SUBMISSIONS REQUIREMENTS

The following items shall be submitted by the Contractor with the Initial and Preliminary Project Schedule submissions and every Periodic Project Schedule Update throughout the life of the project:

3.3.1 Data Disks

[AM#0001]
Three data disks containing the project schedule shall be provided. Data on the disks shall be in the format specified. The automated scheduling software utilized by the Contractor shall be capable of direct data input into the scheduling system currently in use by the Government or shall be in Standard Data Exchange Format (SDEF) as stated below. The Government can provide a list of scheduling programs which support SDEF. (The Government uses Primavera for Windows, Version **3.0**, subject to current update). The Contractor will be responsible for the accuracy of this data and successful data transfer to the Government. In the event of faulty disk(s), the Contractor will be responsible for replacement.

3.3.1.1 Standard Data Exchange Format

If direct exchange of data is not possible, data shall be provided in format according to ER 1-1-11, Appendix A, Scheduling System Data Exchange Format (SDEF) dated 15 June 95. If SDEF is used, records must conform to the sequence, column position, length, value, and field definitions described in the regulation.

3.3.1.2 File Medium

Required data shall be submitted on 3.5 disks, formatted to hold 1.44 MB of data, under the Windows operating system.

3.3.1.3 Disk Label

A permanent exterior label shall be affixed to each disk submitted. The label shall indicate the scheduling program used, format of data transfer (Primavera or SDEF), file name, type of schedule (original, update, or change), contract number, project name, project location, data date, and name and telephone number of person responsible for the schedule.

3.3.1.4 File Name

Each file submitted shall have a name related to either the schedule data

date, project name, or contract number. The Contractor shall develop a naming convention that will insure that the names of the files submitted are unique and in sequence.

3.3.2 Network Diagram

The Network Diagram shall be required on the preliminary and initial schedule submissions and on periodic schedule update submissions. The Network Diagram shall depict and display the order and interdependence of activities and the sequence in which the activities are to be accomplished. Activity numbers, descriptions, durations, milestones and constraint dates must be shown, and the critical path easily apparent. The network diagram must be legible in its electronic form, or another means of production shall be required subject to Contracting Officer approval. Legibility shall be determined upon submission of the Preliminary Schedule.

3.3.3 Narrative Report

A Narrative Report shall be provided with each periodic update of the project schedule. The Narrative Report shall include: a description of activities along the critical path, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions to be taken if necessary to maintain and/or regain schedule. This report shall be provided for use with the updated schedule in evaluating current progress and as an indicator of upcoming progress. This report shall also accompany pay requests for payment evaluation.

3.3.4 Approved Changes

Only project schedule changes that have been previously approved by the Contracting Officer shall be included in the periodic schedule updates.

3.3.5 Schedule Reports

The format for each activity for the schedule reports listed below shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float. Actual Start and Actual Finish Dates shall be printed for those activities in-progress or completed.

3.3.5.1 Activity Report

A list of all activities sorted according to activity number or "AI-NODE" AND "AJ-NODE" and then sorted according to Early Start Date. For completed activities, the Actual Start Date shall be used as the secondary sort.

3.3.5.2 Total Float Report

A list of all activities sorted in ascending order of total float. Activities which have the same amount of total float shall be listed in ascending order of Early Start Dates.

3.3.5.3 Earnings Report

A compilation of the Contractor=s Total Earnings on the project from the Notice to Proceed until the most recent Monthly Progress Meeting.

3.4 PROJECT SCHEDULE

The computer software system utilized by the Contractor to produce the Project Schedule shall be capable of providing all requirements of this specification. Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the schedule.

3.4.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The Contractor shall provide the Project Schedule in the Precedence Diagram Method (PDM).

3.4.2 Level of Detail Required

The Project Schedule shall be at a level of detail appropriate for the size and complexity of the project. Failure to develop or update the Project Schedule or provide data to the Contracting Officer at the appropriate level of detail, as specified by the Contracting Officer, shall result in the disapproval of the schedule. The Contracting Officer will use the following conditions to determine the appropriate level of detail to be used in the Project Schedule.

3.4.3 Activity Durations

Contractor submissions shall be required to follow the direction of the Contracting Officer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods.

3.4.4 Project Activities, General

Project activities shall consist of all construction activities, to include design-related activities, mobilization, demobilization, placement of warranty tags, O&M manuals, jobsite clean-up, and required testing and training. Tasks related to the procurement of long-lead materials or equipment shall be included as separate activities in the project schedule, to include procurement, fabrication, delivery, installation, start-up, testing, and training.

3.4.5 Government Activities

Government and other agency activities that could impact progress shall be shown. These activities include, but are not limited to the review of Government-approved submittals, inspections, utility tie-ins, delivery of Government-furnished equipment (GFE) and issuance of notice to proceed for phasing requirements.

3.4.6 Resources

All appropriate activities shall be assigned resources (labor, materials, equipment) that are expected to be used during the execution of the activity.

3.4.7 Costs

All work activities shall be cost-loaded with the amount budgeted. The sum of all activities in the schedule shall equal the total contract amount.

3.4.8 Responsibility

All activities shall be identified in the project schedule by the party responsible for performing the work. Responsibility includes, but is not limited to, the subcontracting firm, contractor work force, or government agency performing a given task.

3.4.9 Work Areas

All activities shall be identified in the project schedule by the work area in which the activity occurs.

3.4.10 Modification Number

Any activity that is added or changed by contract modification, including modifications for claims, shall be identified by a Government-furnished Modification number.

3.4.11 Bid Item

All activities shall be identified in the project schedule by the Bid Item to which the activity belongs. The bid item for each appropriate activity shall be identified by the Bid Item Code.

3.4.12 Phase of Work

All activities shall be identified in the project schedule by the phases of work in which the activity occurs. The project phase of each activity shall be by a unique Phase of Work Code.

3.4.13 Category of Work

All Activities shall be identified in the project schedule according to the category of work which best describes the activity. Category of work refers, but is not limited to, the procurement chain of activities including such items as submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing. The category of work for each activity shall be identified by the Category of Work Code.

3.4.14 Data Dictionary

The Contractor shall submit a coding scheme that shall be used throughout the project for all activity codes contained in the schedule. The coding scheme submitted shall list the values for each activity code category and translate those values into project specific designations. For example, a Responsibility Code Value, "ELE", may be identified as "Electrical Subcontractor." Activity code values shall represent the same information throughout the duration of the contract.

3.4.15 Project Start Date

The schedule shall start no earlier than the date that the Notice to Proceed (NTP) is acknowledged. The Contractor shall include as the first activity in the project schedule an activity called "Start Project" or

similar. The "Start Project" activity shall have a constraint date equal to the date that the NTP was acknowledged and a zero day duration.

3.4.16 Constraint of Last Activity

The Contractor shall include as the last activity in the project schedule an activity call "End Project". The "End Project" activity shall have a constraint date equal to the completion date for the project and a zero day duration. Completion of the last activity in the schedule shall be constrained by the currently approved contract completion date. Calculation on project updates shall be such that if the early finish of the last activity falls after the contract completion date, then the float calculation shall reflect a negative float on the critical path.

3.4.17 Interim Completion Dates

Contractually specified interim phasing completion dates shall also be constrained to show negative float if the early finish date of the last activity in that phase falls after the interim completion date.

3.4.18 Start Phase

The Contractor shall include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have a constraint date equal to the date that the NTP for the phase was acknowledged and a zero day duration.

3.4.19 End Phase

[AM#0001]
The Contractor shall include as the last activity in a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have a constraint date equal to the completion date for the phase____ and a zero day duration.

3.4.20 Lag Activities

Duration for Lag Activities shall not have negative value.

3.4.21 Open Ends

Open Ended Activities other than the last activity, " End Project", shall only be used with approval of the Contracting Officer.

3.4.22 Ownership of Float

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor. Use of Zero Free Float and Zero Total Float constraints shall not be allowed.

3.5 BASIS FOR PAYMENT

The schedule shall be the basis for measuring Contractor progress. Lack of an approved schedule, scheduling personnel, or approved periodic schedule updates shall result in an inability of the Contracting Officer to evaluate Contractor progress for the purposes of payment. In this event, progress payments will not be made until corrective action or additional information

is provided which is determined sufficient in the judgement of the contracting Officer to analyze progress. The contractor's pay estimates will be based upon the amount of work completed, as agreed upon between Government and Contractor personnel during the Periodic Progress Meetings further specified below.

3.6 DEFAULT PROGRESS DATA DISALLOWED

Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual Start and Finish dates on the CPM schedule shall match those dates provided from Contractor Quality Control Reports.

3.7 OUT-OF-SEQUENCE PROGRESS

Activities that have posted progress without predecessors being completed (Out-of-Sequence Progress) shall be allowed only by the case-by-case approval of the Contracting Officer. If approval is not given, a revised schedule that reflects corrections to the original logic to show the current sequence of activities shall be submitted prior to payment being made for those items of work.

3.8 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss progress or payment shall be at regular intervals mutually agreed to at the preconstruction conference. During this meeting the Contractor will describe, on an activity by activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project. During this meeting, the Contracting Officer or Representative will approve activity progress, proposed revisions, and adjustments as appropriate.

3.8.1 Meeting Attendance

The Contractor's Project Manager, Quality Control Manager or staff, and Scheduler shall attend the periodic progress meeting along with similar representation by the Government.

3.8.2 Update Submission Following Progress Meeting

A complete update of the project schedule containing all approved progress, revisions, and adjustments, based on the regular progress meeting, shall be submitted not later than seven (7) working days after the periodic progress meeting.

3.8.3 Progress Meeting Agenda

Update information, including Actual Start Dates, Actual Finish Dates, Remaining Durations, and Cost to Date shall be subject to the approval of the Contracting Officer. The following is a minimum set of items which the Contractor shall address, on an activity by activity basis, during each progress meeting:

3.8.3.1 Start and Finish Dates

The Actual Start and Actual Finish dates for each activity currently inprogress or completed.

3.8.3.2 Duration

The estimated Remaining Duration for each activity in progress; calculations must be based on Remaining Duration in applicable work periods for each activity.

3.8.3.3 Cost

The earnings for each activity started. Payment shall be based on earnings for each in-progress or completed activity. Payment for individual activities shall not be made for work that contains quality defects. A portion of the overall project amount may be retained based on lack of satisfactory progress.

3.8.3.4 Logic Changes

All logic changes pertaining to Notice to Proceed on change orders, change orders to be incorporated into the schedule, contractor-proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, lag durations, and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

3.9 REQUESTS FOR TIME EXTENSIONS

Any request for a time extension from the Contractor, whether as a result of added or changed work due to a modification, a differing site condition, or unusually severe weather, shall be accompanied by justification, project schedule data and supporting evidence as the Contracting Officer may deem necessary for a determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is obligatory to any approvals. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

a. A list of affected activities.

b. A brief explanation of the causes of the change.

c. An analysis of the overall impact of the change proposed.

d. A sub-network of the affected area.

Activities impacted in each justification for change shall be identified by a unique activity code contained in the required data file.

3.10 DIRECTED CHANGES

If Notice to Proceed (NTP) is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Contracting Officer within seven (7) calendar days of the NTP being issued. The proposed revisions to the schedule will be approved by the Contracting Officer prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor suggested revisions to the

project schedule. The Contractor shall include these revisions in the project schedule until the Contractor submits revisions, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, then the Contractor shall advise the Contracting Officer within seven (7) calendar days of receipt of the revisions. Regardless of the objections, the Contractor will continue to update their schedule with the Contracting Officer's revisions until a mutual agreement in the revisions may be made. If the Contractor fails to submit alternative revisions within seven (7) calendar days of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

-- End of Section --

SECTION 02220

DEMOLITION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Work Plan; GA.

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

1.4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to

avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

1.5 PROTECTION

1.5.1 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.5.2 Protection of Structures

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, of lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.3 Protection of Existing Property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.4 Protection From the Weather

The interior of buildings to remain; salvageable materials and equipment shall be protected from the weather at all times.

1.5.5 Protection of Trees

Trees within the project site which might be damaged during demolition, and which are indicated to be left in place, shall be protected by a 1.8 m (6 foot) high fence. The fence shall be securely erected a minimum of 1.5 m from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

1.5.6 Environmental Protection

The work shall comply with the requirements of Section 01410 ENVIRONMENT PROTECTION.

1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.7 USE OF EXPLOSIVES

Use of explosives will not be permitted.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 [AM#0001] DELETED

3.2 UTILITIES

Disconnection of utility services, with related meters and equipment, are specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

3.3 FILLING

Holes, [AM#0001] _____ and other hazardous openings shall be filled in accordance with Section 02315 EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS.

3.4 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed. Non segregated loads of construction debris shall be disposed of in a landfill legally permitted by the State of Texas. Source segregated, non contaminated (by process knowledge or analysis), concrete, asphalt, and soil may be disposed of outside of Texas permitted landfill with prior approval of the Contracting Officer. The contractor shall be responsible for ensuring source seggregated loads contain no contaminants.

3.4.1 Salvageable Items and Material

Contractor shall salvage items and material to the maximum extent possible.

3.4.1.1 Material Salvaged for the Contractor

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

3.4.1.2 Historical Items

Historical items shall be removed in a manner to prevent damage. The following historical items shall be delivered to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

3.4.2 Unsalvageable Material

Concrete, masonry, and other noncombustible and combustible material, except concrete permitted to remain in place, shall be disposed of off the site.

3.5 CLEAN UP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

3.6 PAVEMENTS

Existing pavements designated for removal shall be saw cut and removed in accordance with the details shown on the drawings and to the limits and depths indicated on the drawings.

-- End of Section --

SECTION 03201

STEEL BARS AND WELDED WIRE FABRIC FOR CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 315	(1995) ACI Detailing Manual: Section Details and Detailing of Concrete Reinforcement
ACI 318M/318RM	(1995) Building Code Requirements for Reinforced Concrete (Metric)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1994) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 370	(1995a) Mechanical Testing of Steel Products
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	(1996b) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM E 94	(1993) Radiographic Testing

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4	(1992) Structural Welding Code - Reinforcing Steel

1.2 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Fabrication and Placement; GA.

The Contractor shall submit shop drawings which include: reinforcement steel placement drawings; reinforcement steel schedules showing quantity, size, shape, dimensions, weight per meter, total weights and bending details; and details of bar supports showing types, sizes, spacing and

sequence.

SD-08 Statements

Butt-Splices; GA.

The Contractor shall submit the proposed procedure for butt-splicing steel bars prior to making the test butt-splices for qualification of the procedure. Properties and analyses of steel bars and splicing materials shall be included in the submitted procedure. Physical properties of splicing sleeves shall include length, inside and outside diameters, and inside surface details.

SD-09 Reports

Materials; GA. Tests, Inspections, and Verifications; GA.

Certified tests reports of reinforcement steel showing that the steel complies with the applicable specifications shall be furnished for each steel shipment and identified with specific lots prior to placement. Three copies of the heat analyses shall be provided for each lot of steel furnished and the Contractor shall certify that the steel conforms to the heat analyses.

SD-14 Samples

Epoxy-Coated Bars; FIO.

Sample of coating material and 700 g of patching material shall be submitted with the delivery of the bars.

SD-18 Records

Material; GA.

A system of identification which shows the disposition of specific lots of approved materials in the work shall be established and submitted before completion of the contract.

Welding; FIO.

A list of qualified welders names.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the following requirements.

2.1.1 Steel Bars

Steel bars shall comply with the requirements of ASTM A 615/A 615M or ASTM A 706/A 706M, deformed, of the grades, sizes and lengths shown.

2.1.1.1 [AM#0001] DELETED.

2.1.2 Steel Welded Wire Fabric

Steel welded wire fabric shall comply with the requirements of ASTM A 185

wire sizes and spacings as shown. For wire with a specified yield strength (fy) exceeding 400 MPa, fy shall be the stress corresponding to a strain of 0.35 percent.

2.1.3 Accessories

2.1.3.1 Bar Supports

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 100 by 100 mm when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 13 mm of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

2.1.3.2 Wire Ties

Wire ties shall be 16 gage or heavier black annealed wire. Ties for epoxy-coated bars shall be vinyl-coated or epoxy-coated. Ties for zinc-coated bars shall be zinc-coated.

2.2 SYNTHETIC FIBER REINFORCEMENT

Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 50 mm. Synthetic fiber shall be 100 percent virgin multifilament polypropylene fibers containing no reprocessed olefin materials and spcifically engineered and manufactured in ISO 9002 certified facility for use as concrete secondary reinforcement. Fiber manufacturer must document evidence of 5 year satisfactory performance history, compliance with applicable building codes and ASTM C-1116 Type III, A.1.3. Fibrous concrete reinforcement shall be invisible on the hardened concrete surface.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

The Contractor shall have material tests required by applicable standards and specified performed by an approved laboratory and certified to demonstrate that the materials are in conformance with the specifications. tests, inspections, and verifications shall be performed and certified at the Contractor's expense.

2.3.1 Reinforcement Steel Tests

Mechanical testing of steel shall be in accordance with ASTM A 370 except as otherwise specified or required by the material specifications. Tension tests shall be performed on full cross-section specimens using a gage length that spans the extremities of specimens with welds or sleeves included. Chemical analyses of steel heats shall show the percentages of carbon, phosphorous, manganese, sulphur and silicon present in the steel.

2.3.2 Qualification of Steel Bar Butt-Splicers

Qualification of steel bar butt-splicers shall be certified to have

satisfactorily completed a course of instruction in the proposed method of butt-splicing or have satisfactorily performed such work within the preceding year.

2.3.3 Qualification of Butt-Splicing and Mechanical Connector Procedure

As a condition of approval of the butt-splicing and mechanical splicing procedure, the Contractor, in the presence of the Contracting Officer, shall make three test mechanical splices and butt-splices of steel bars of each size to be spliced using the proposed butt-splicing and mechanical splicing method. These test butt-splices, and mechanical splices and unspliced bars of the same size shall be tension tested to destruction with stress-strain curves plotted for each test. Test results must show that the butt-splices and mechanical splicing meet the specified strength and deformation requirements in order for the splicing procedure to be approved.

2.3.4 Radiographic Examination of Welds

Radiographic examination of welds shall be in accordance with ASTM E 94 and shall be performed and evaluated by an approved testing agency adequately equipped to perform such services. Radiographs of welds and evaluations of the radiographs submitted for approval shall become the property of the Government.

PART 3 EXECUTION

3.1 FABRICATION AND PLACEMENT

Reinforcement steel and accessories shall be fabricated and placed as specified and shown and approved shop drawings. Fabrication and placement details of steel and accessories not specified or shown shall be in accordance with ACI 315 and ACI 318M/318RM or as directed. Steel shall be fabricated to shapes and dimensions shown, placed where indicated within specified tolerances and adequately supported during concrete placement. At the time of concrete placement all steel shall be free from loose, flaky rust, scale (except tight mill scale), mud, oil, grease or any other coating that might reduce the bond with the concrete.

3.1.1 Hooks and Bends

Steel bars, except for zinc-coated or epoxy-coated, shall be mill or field-bent. Zinc-Coated and epoxy-coated bars shall be mill-bent prior to coating. All steel shall be bent cold unless authorized. No steel bars shall be bent after being partially embedded in concrete unless indicated or authorized.

3.1.2 Welding

Welding of steel bars will be permitted only where indicated or authorized. Welding shall be performed in accordance with AWS D1.4 except where otherwise specified or indicated. Welders shall be qualified in accordance with AWS D1.4. Qualification test shall be performed at the worksite and the Contractor shall notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4.

3.1.3 Placing Tolerances

3.1.3.1 Spacing

The spacing between adjacent bars and the distance between layers of bars may not vary from the indicated position by more than one bar diameter nor more than 25 mm.

3.1.3.2 Concrete Cover

The minimum concrete cover of main reinforcement steel bars shall be as shown. The allowable variation for minimum cover shall be as follows:

MINIMUM COVER	VARIATION
150 mm	plus 13 mm
100 mm	plus 10 mm
75 mm	plus 10 mm
50 mm	plus 6 mm
38 mm	plus 6 mm
25 mm	plus 3 mm
19 mm	plus 3 mm

3.1.4 Splicing

Splices in steel bars shall be made only as required. Bars may be spliced at alternate or additional locations at no additional cost to the Government subject to approval.

3.1.4.1 Lap Splices

Lap splices shall be used only for bars smaller than size 45 and welded wire fabric. Lapped bars may be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than 1/5 the required length of lap or 150 mm.

3.1.4.2 Butt-Splices

Butt-splices shall be used only for splicing size 45 and 55 bars and for splicing #36 bars to larger bars except where otherwise shown or authorized. Butt-splices shall be made by a method which develops splices suitable for tension, compression and stress reversal applications. Welded butt-splices shall be full penetration butt welds. Butt-splices shall develop 90 percent of the specified minimum ultimate tensile strength of the smallest bar of each splice. Bars shall be cleaned of all oil, grease, dirt, rust, scale and other foreign substances and shall be flame dried before splicing. Adequate jigs and clamps or other devices shall be provided to support, align and hold the longitudinal centerline of the bars to be butt-spliced in a straight line. Butt-splices shall be as follows:

a. Thermit Welded Butt Splices - Bars to be thermit welded shall be restricted to steel shown by heat analysis to have a sulfur content not exceeding 0.05 percent. The ends of bars to be thermit welded shall be cut square and smooth. Flame cutting will be permitted provided grinding is employed to remove the resulting scale and to square and smooth the cut ends to a condition equivalent to a saw cut. No shearing will be permitted. Bars shall be cleaned and flame dried before splicing. The joint shall be properly aligned in the mold with a gap opening in accordance with the manufacturer's recommendations. Charging and firing shall conform to the manufacturer's recommendations. The end of bars and the welded mold shall be

preheated before welding to a temperature of not less than 40 degrees C and the mold shall be left in place for at least 15 minutes after ignition. Risers shall be broken or burned off after removing the mold. Tension splices shall be staggered longitudinally a minimum of 1500 mm so that no more than half of the bars are spliced at any one section or as otherwise indicated.

b. Mechanical Butt-Splices - Mechanical butt-splices shall be an approved exothermic, threaded coupling, swaged sleeve or other positive connecting type. Bars to be spliced by a mechanical butt-splicing process may be sawed, sheared or flame cut provided the ends of sheared bars are reshaped after shearing and all slag is removed from the ends of flame cut bars by chipping and wire brushing prior to splicing. Surfaces to be enclosed within a splice sleeve or coupling shall be cleaned by wire brushing or other approved method prior to splicing. Splices shall be made using manufacturer's standard jigs, clamps, ignition devices and other required accessories. In addition to the strength requirements specified paragraph BUTT-SPLICES the additional deformation of number 45 and smaller bars due to slippage or other movement within the splice sleeve shall not exceed 0.38 mm (unit strain 0.0015 mm/mm) beyond the elongation of an unspliced bar based upon a 250 mm gage length spanning the extremities of the sleeve at a stress of 200 MPa. The additional deformation of number 55 bars shall not exceed 0.75 mm (unit strain 0.003 mm/mm) beyond the elongation of an unspliced bar based upon a 250 mm gage length spanning the extremities of the sleeve at a stress of 200 MPa . The amount of the additional deformation shall be determined from the stress-strain curves of the unspliced and spliced bars tested as required paragraph QUALIFICATION OF BUTT-SPLICING PROCEDURE for qualification of the butt-splicing procedure. Tension splices of number 45 or smaller bar shall be staggered longitudinally a minimum of 1500 mm or as otherwise indicated so that no more than half of the bars are spliced at any one section. Tension splices of number 55 bars shall be staggered longitudinally a minimum of 1500 mm so that no more than 1/3 of the bars are spliced at any one section.

3.2 FIELD TESTS AND INSPECTIONS

3.2.1 Butt-Splices

3.2.1.1 Identification of Splices

The Contractor shall establish and maintain an approved method of identification of all field splices which will indicate the splicer and the number assigned each splice made by the splicer.

3.2.1.2 Examining, Testing, and Correcting

The Contractor shall perform the following during the butt-splicing operations as specified and as directed:

a. Visual Examination - All welded splices shall be visually examined for the presence of cracks, undercuts, inadequate size and other visible defects. Respliced connections resulting from correction of visual defects may be radiographically examined at the option of the Contracting Officer as specified in paragraph SUPPLEMENTAL EXAMINATION. Exothermic mechanical butt-splices shall be visually examined to determine if the filler metal is clearly visible at the tap holes and completely fills the sleeves at both ends except for spaces of not more

than 10 mm occupied by packing.

b. Tension Tests - Tensions tests to 90 percent of the minimum specified ultimate tensile strength of the spliced bars or to destruction shall be performed on one test specimen made in the field for every 25 splices made. Test specimens shall be made by the splicers engaged in the work, using the approved splicing procedure and the same size bars placed in the same relative position, and under the same conditions as those in the groups represented by the specimens. Stress-strain curves shall be furnished for each butt-splice tested.

c. Radiographic Examination - Not less than one of each 25 welded splices selected at random by the Contracting Officer shall be examined radiographically and evaluated for defects. The greatest dimension of any porosity (gas pocket or similar void) or fusion-type defect (slag inclusion, incomplete fusion or similar generally elongated defect in weld fusion) shall not exceed 6 mm . The minimum clearance between edges of porosity or fusion-type defects shall not be less than 25 mm .

d. Correction of Deficiencies - No splice shall be embedded in concrete until satisfactory results of visual examination and the required tests or examinations have been obtained. All splices having visible defects or represented by test specimens which do not satisfy the tests or examinations shall be removed. If any of the tension test specimens fail to meet the strength requirements or deformation limitations two production splices from the same lot represented by the test specimens which failed shall be cut out and tension tested by the Contractor. If both of the retests pass the strength requirements and deformation limitations all of the splices in the lot will be accepted. If one or both of the retests fail to meet the strength requirements or deformation limitations all of the splices in the lot will be rejected. All costs of removal, testing and resplicing of the additional production splices shall be borne by the Contractor. The bars of rejected splices shall be cut off outside the splice zone of weld metal, filler metal contact, coupling or sleeve. The cut ends shall be finished as specified and the joints shall be respliced and reinspected at no additional cost.

e. Supplemental Examination - The Contracting Officer may require additional or supplemental radiographic examination and/or tension test of any completed splice. For costs of such examinations and tests see paragraph UNIT PRICES.

-- End of Section --

SECTION 05400
COLD-FORMED STEEL FRAMING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI Cold-Formed Spec	(1996) Specification & Commentary for the Design of Cold-Formed Steel Structural Members (Part V of the Cold-Formed Steel Design Manual)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 370	(1997a) Mechanical Testing of Steel Products
ASTM A 653/A 653M	(1997) Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 633	(1985; R 1994) Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 955	(1996a) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
ASTM C 1007	(1998) Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories
ASTM E 329	(1995c) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

AMERICAN WELDING SOCIETY (AWS)

AWS D1.3	(1989) Structural Welding Code - Sheet Steel

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J 78 (1979) Steel Self Drilling Tapping Screws

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Cold-Formed Steel Framing; GA.

a. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.

b. Connection details showing fastener type, quantity, location, and other information to assure proper installation.

c. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.

SD-13 Certificates

Mill Certificates; FIO.

Mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E 329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports shall be based on the results of three coupon tests in accordance with ASTM A 370.

Welding Certificates; FIO.

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3.

1.3 DELIVERY, HANDLING AND STORAGE

Materials shall be delivered and handled preventing bending or other damage, and avoiding contact with soil or other contaminating materials. Finish of the framing members shall be maintained at all times, using an approved high zinc dust content, galvanizing repair paint whenever necessary to prevent the formation of rust.

PART 2 PRODUCTS

2.1 STEEL STUDS, TRACKS, BRACING, BRIDGING, AND ACCESSORIES

Framing components shall comply with ASTM C 955 and the following:

a. Material shall be corrosion-resistant steel complying with ASTM A 653/A 653M, Grade 230 or higher, having a minimum yield of 230 MPa and a G [AM#0001] 90 minimum zinc coating.

b. Minimum uncoated steel thickness (design thickness times 0.95):

(1). Studs and Tracks: 1.72 mm minimum.

(2). Bracing and bridging: Thickness as shown on the drawings.

(3). Accessories: Standard thickness as provided by the manufacturer.

c. Stud and Track web depth: As shown on the draiwngs.

d. Stud flange width: 41 mm minimum.

e. Minimum stud effective section properties as shown on the drawings:

(1). Sx = 9,500 mm^3

(2). Ix = 480,000 mm^4

(3). Mx = 1,950 N-m

2.2 MARKINGS

Studs and track shall have product markings on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 1200 mm on center and shall be legible and easily read. The product marking shall include the following:

a. Manufacturer's identification.

b. Minimum delivered uncoated steel thickness.

c. Protective coating designator.

d. Minimum yield strength.

2.3 CONNECTIONS

Screws for steel-to-steel connections shall be self-drilling tapping in compliance with SAE J 78 of the type, size, and location as shown on the drawings. Electroplated screws shall have a Type II coating in accordance with ASTM B 633. Screws, bolts, and anchors shall be hot-dipped galvanized in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M as appropriate. Screws bolts, and anchors shall be hot dipped galvanized in accordance with ASTM A 123/A 123Mor ASTM A 153/A 153M as appropriate.

PART 3 EXECUTION

3.1 Delivery, Handling and Storage

a. Materials shall be delivered and handled in a manner to avoid bending or other damage and to avoid contact with the soil or other contaminating materials.

b. Finish of the framing members shall be maintained at all times, using an approved high zinc dust content galvanizing repair paint whenever necessary to prevent the formation of rust.

3.2 CONNECTIONS

3.2.1 Welds

All welding shall be performed in accordance with AWS D1.3, as modified by AISI Cold-Formed Spec. All welders, welding operations, and welding procedures shall be qualified according to AWS D1.3. All welds shall be cleaned and coated with rust inhibitive galvanizing paint.

3.2.2 Screws

Screws shall be self-drilling type, size, and location shown on the drawings. Screw penetration through joined materials shall not be less than three exposed threads. Minimum spacings and edge distances for screws shall be as specified in AISI Cold-Formed Spec. Screws covered by sheathing materials shall have low profile heads.

3.2.3 Anchors

Anchors shall be of the type, size, and location shown on the drawings.

3.3 INSTALLATION

3.3.1 General Requirements

a. Prefabricated frames shall be square, with components attached to prevent racking during fabrication, transportation, and lifting. Design and construction of frames shall include provisions for lifting.

b. Cutting of steel framing shall be by saw, shear, or plasma cutting equipment. Oxyacetylene torch cutting is not permitted.

c. Temporary bracing shall be provided and remain in place until work is permanently stabilized.

d. Abutting lengths of track shall be butt-welded, spliced, or each length securely anchored to a common structural element. Track shall be securely anchored to the supporting structure as shown on the drawings.

e. Splicing of framing components, other than track and tension members, is not permitted.

f. Wire tying of framing members is not permitted.

3.3.2 Non-Load Bearing Walls (Curtain walls)

a. Studs shall be spaced at 400 mm maximum on center.

b. Studs shall be plumbed, aligned, and secured to the continuous runner tracks at each end, unless the stud end terminates at a deflection track.

c. Tracks shall be securely anchored to the supporting structure as shown on the drawings.

d. Bridging spaced at 1200 mm shall be installed prior to the

installation of facing materials.

e. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings that are larger than the stud spacing in a wall.

f. At wall openings for doors, windows and other similar features, the framing system shall provide for the installation and anchorage of the required subframes or finish frames. Steel frames shall be securely attached through built-in anchors to the nearest stud on each side of the opening with self-drilling screws. Double studs shall be provided at both jambs of all door openings.

g. Installation of sheathing, wallboards, or any other collateral material shall be performed in accordance with the product manufacturer's specifications.

h. Components (Deflection Track and/or Slide Clips) shall be provided at locations shown on the drawings to accommodate potential movements of Primary Frames. Construction shall accommodate a vertical movement of 13 mm where it requires.

3.3.3 Load Bearing Walls

3.3.3.1 Axial Load

Installation shall comply with ASTM C 1007 and the following:

a. Studs shall be spaced at 400 mm on center.

b. Studs shall be installed seated squarely against the web of the top and bottom track to assure transfer of axial load. Studs shall be plumbed, aligned, and secured to the continuous runner tracks at each end before the installation of components which induce axial load.

c. Studs, other than at framed openings, shall align vertically to allow for full transfer of the loads to the foundation. Vertical alignment shall be maintained at floor/wall intersections. Where vertical alignment is not possible. An extra stud shall be added to support the stud above.

d. Foundation bearing bottom track shall rest on a continuous, uniform, and level beating surface.

e. Tracks shall be securely anchored to the supporting structure as shown on the drawings.

f. Bridging spaced shall be installed prior to loading and the installation of facing materials.

g. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings which are larger than the stud spacing in a wall.

h. At wall openings for doors, windows and other similar features, the framing system shall provide for the installation and anchorage of the required subframes or finish frames. Steel

frames shall be securely attached through built-in anchors to the nearest stud on each side of the opening with self-drilling screws. Double studs shall be provided at both jambs of all door openings.

i. Installation of sheathing, wallboards, or any other collateral material shall be performed in accordance with the product manufacturer's specifications.

3.4 TOLERANCES

Vertical alignment (plumbness) of studs shall be within 1/960th of the span. Horizontal alignment (levelness) of walls shall be within 1/960th of their respective lengths. Spacing of studs shall not be more than plus 3 mm from the designed spacing providing the the cumulative error does not exceed the requirements of the finishing material.

-- End of Section --

SECTION 07551

MODIFIED BITUMEN ROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 208	(1995) Cellulosic Fiber Insulating Board
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 312	(1995a) Asphalt Used in Roofing
ASTM D 3746	(1985; R 1996) Impact Resistance of Bituminous Roofing Systems
ASTM D 4586	(1993) Asphalt Roof Cement, Asbestos Free
ASTM D 4601	(1997) Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D 5147	(1997) Sampling and Testing Modified Bituminous Sheet Material

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825c	(1997) Approval Guide Building Materials

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(1997) Building Materials Directory
UL 790	(1995) Tests for Fire Resistance of Roof Covering Materials
UL 1256	(1993; Rev thru Apr 1996) Fire Test of Roof Deck Constructions

1.2 SYSTEM DESCRIPTION

The modified bitumen roofing system shall consist of a manufacturer's standard, prefabricated, reinforced polymer-modified bitumen membrane, with base sheet, and insulation as specified and indicated. The manufacturer shall have a minimum of 5 years experience in manufacturing of the proposed modified bitumen sheet roofing for similar applications.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Instructions

Materials and Installation; FIO.

Manufacturer's instructions, including membrane description and performance data, detailed procedure for installation, and safety precautions, prior to the start of roofing work.

SD-13 Certificates

Qualifications; FIO.

Evidence that the manufacturer has a minimum of 5 years experience manufacturing modified bitumen roofing. The roofing system applicator shall be approved by the modified bitumen roofing manufacturer, and shall have a minimum of 3 years experience as an approved applicator. A list of installations using the same products and applicator as proposed shall be included.

Materials; FIO.

Certificates of compliance for felts, bitumens, and membrane sheet.

SD-18 Records

Bills of Lading; FIO.
Bills of lading shall indicate the flash point and equiviscous temperature (EVT) and this information shall be shown on labels for each unit (or plug) of asphalt.

1.4 STORAGE OF MATERIALS

Felts and roofing sheets shall be kept dry before, during, and after delivery to the site. Felts and roofing sheets shall be stored on end one level high, in an enclosed building or trailer and on platforms, off the deck or floor. Felts and sheets shall be maintained at a temperature above 10 degrees C for 24 hours immediately before laying.

1.5 COORDINATION REQUIREMENTS

The work shall be coordinated with other trades to ensure that components are available when they are to be secured or stripped into the roofing system.

1.5.1 Insulation Application

Application of roofing shall immediately follow application of insulation as a continuous operation.

1.5.2 Flashing

Modified bituminous sheet shall be used for flashings where the roof deck abuts angles, vertical surfaces, edge metal, and penetrations, unless otherwise specified or indicated. Flashing shall be installed as the work

progresses.

1.5.3 Sheet Metalwork

Sheet metalwork specified in Section 07600 SHEET METALWORK, GENERAL shall be coordinated with roofing operations.

1.6 ENVIRONMENTAL CONDITIONS

Air temperature shall be above 4 degrees C and there shall be no visible ice, frost, or moisture on the roof deck at the time roofing is installed.

1.7 FLAME HEATED EQUIPMENT

Flame heated kettles shall not be placed on the roof. Torch application shall be approved by the membrane manufacturer for the specific modified bitumen. Open flame equipment shall not be left unattended while ignited.

1.8 ELECTRIC-HEATED EQUIPMENT

Adequate electrical service shall be provided as required by the manufacturer of the equipment, to insure proper application of the roofing materials.

1.9 FIRE AND WIND UPLIFT REQUIREMENTS

The complete roof system shall have a UL 1256, UL 790, Class A or B classification, be listed as "fire classified" in UL Bld Mat Dir, and bear the UL label or be listed as a Class I Roof Deck in FM P7825c. Roofing system over steel deck shall be rated Class I- 120 in accordance with FM P7825c. Ratings from other independent laboratories may be substituted provided that the tests, requirements and ratings are documented to be equivalent, to the satisfaction of the Contracting Officer.

1.10 WARRANTY

Manufacturer's standard warranty signed by manufacturer and installer for the roofing system shall be provided for not less than 10 years from acceptance of the work. Warranty shall state that manufacturer shall repair or replace defective materials if the roofing system leaks or allows the insulation beneath the membrane to become wet during the period of the warranty.

PART 2 PRODUCTS

2.1 PRIMER

Primer shall conform to ASTM D 41.

2.2 ASPHALT

Asphalt shall conform to ASTM D 312, Type III for slopes up to 25 percent (1/4 vertical/horizontal) and Type IV for slopes up to 50 percent (1/2 vertical/horizontal).

2.3 BITUMINOUS CEMENT

Bituminous cement shall conform to ASTM D 4586.

2.4 CANTS AND WOOD NAILERS

Treated wood cants and wood nailers shall be of water-borne preservative-treated material as specified in Section 06100 ROUGH CARPENTRY. Cants shall be made from treated wood or treated fiberboard not less than 89 mm high and cut to reduce change in direction of the membrane to 45 degrees or less. Fiberboard shall conform to ASTM C 208, treated with sizing, wax or bituminous impregnation. When membrane or flashing is to be torch applied, cants shall be fire resistant.

2.5 BASE SHEET

Non venting base sheet shall conform to ASTM D 4601, Type II.

2.6 MODIFIED BITUMEN SHEET

Modified bitumen sheet shall be a bitumen modified by atactic polypropylene (APP) or styrene butadiene styrene (SBS); or modified by SBS which has been further modified with styrene ethylene butadiene styrene (SEBS). Sheets shall be uniform in thickness and appearance, and free from blisters or tape splices. Sheets shall not stick to the roll or stack, and shall be suitable for joining along the entire length by the procedure recommended by the manufacturer. Sheet shall be reinforced with fiber made from glass, polypropylene, or polyester, and shall meet the following requirements:

MODIFIED BITUMEN SHEET PROPERTIES

Maximum Load/Elongation, ASTM D 5147, weakest (longitudinal or transverse) direction:

Maximum load, minimum	15 KN/m
Elongation, minimum; when reinforced with:	
glass fiber	3 percent
polyester or polypropylene	40 percent
Tear Strength, ASTM D 5147 Minimum	356 N
Low Temperature Flexibility, ASTM D 5147	SBS: minus 26 degrees C APP: minus 9.4 degrees C
Impact Resistance, ASTM D 3746	No Damage

2.7 NAILS AND FASTENERS

Nails and fasteners shall be an approved type recommended by the roofing felt or membrane manufacturer.

2.8 SURFACING MATERIAL

Surfacing shall be factory applied granules requiring no further coating. Provide adequate quantity of loose granules matching granules applied at factory to cover full length of all lap seams when sprinkled on adhesive seepage.

2.9 ADHESIVE

Adhesive shall be an approved type recommended by the membrane manufacturer.

2.10 INSULATION

Insulation shall be compatible with the membrane, as recommended by the membrane manufacturer's printed instructions, and as specified in Section 07220 ROOF INSULATION.

2.11 [AM#0001] LOOSE GRANULES

Provide mineral granules identical to those applied to cap sheet by manufacturer. Provide 25 pounds loose granules for extra stock for future use when making repairs to roof.

PART 3 EXECUTION

3.1 PREPARATION REQUIREMENTS

The substrate construction of any bay or section of the building shall be completed before roofing work is begun thereon. Vents and other items penetrating the roof shall be secured in position and properly prepared for flashing. Nailers, curbs and other items attached to roof surface shall be in place before roofing is begun.

3.2 INSTALLATION OF CANTS

Cants shall be installed in the angles formed between the roof and walls or other vertical surfaces. Cants shall be laid in a solid coat of bituminous cement just prior to laying the base sheet or membrane. Cants shall be continuous, and shall be installed in lengths as long as practicable.

3.3 CONDITION OF SURFACES

Surfaces shall be inspected and approved immediately prior to application of roofing and flashings. The roofing and flashings shall be applied to a smooth and firm surface free from ice, frost, visible moisture, dirt, projections, and foreign materials. Prior to application of primer on precast concrete decks, joints shall be covered with a 100 mm strip of roofing felt, embedded in and coated with bituminous cement. Modified bitumen membrane shall be isolated from coal tar pitch.

3.4 MECHANICAL APPLICATION DEVICES

Mechanical application devices shall be mounted on pneumatic-tired wheels, and shall be designed and maintained to operate without damaging the insulation, roofing membrane, or structural components.

3.5 PRIMING

Concrete, masonry and metal surfaces to receive bitumen shall be uniformly coated with primer at a rate of not less than 0.4 liter per square meter and allowed to dry.

3.6 HEATING OF BITUMEN

Asphalt shall not be heated higher than 42 degrees C above the EVT or 28 degrees C below the flash point or 274 degrees C (maximum) whichever is lower. EVT and flash point temperatures of asphalt in the kettle shall be conspicuously posted on the kettle. Heating kettle shall be provided with automatic thermostatic control and an accurate thermometer. Kettle operators shall be in attendance at all times during the heating to ensure

that the maximum temperature specified is not exceeded. An asphalt tanker shall be treated as a kettle.

3.7 BITUMEN APPLICATION

Asphalt shall be applied within 14 degrees C below or above the EVT, or 204 degrees C, whichever is higher. Application temperatures shall be measured at the mop bucket or mechanical applicator. Bitumen at a temperature below the recommended temperature shall be returned to the kettle.

3.8 APPLICATIONS OF BASE SHEET

Base sheet shall be applied, shingle fashion, in a continuous operation, with side laps in accordance with manufacturer's printed instructions. End laps shall be not less than 150 mm and staggered a minimum of 600 mm. Base sheets shall be applied at right angles to the slope (except on curved or steep deck) and laps shall face down the slope. Non venting base sheet shall be applied in hot mopping of not less than 0.97 kg nor more than 1.7 kg of asphalt per square meter and shall be embedded in the hot asphalt with a squeegee or broom to eliminate air pockets and assure complete adhesion. Operator shall avoid heavy application of squeegees to glass-fiber sheets.

3.9 MODIFIED BITUMEN MEMBRANE APPLICATION

Membrane shall be two plies . Each sheet in each ply shall be fully adhered to the underlying surface. Sheet edges shall lie flat, with no fishmouths or wrinkles. Installation shall begin at the low point of the roof and progress to the high point with each sheet installed shingle fashion. Each sheet shall be unrolled to provide 100 mm side laps and 150 mm end laps. End laps shall be staggered not less than 600 mm. Laps shall not coincide with laps of base layers except at lines of permanent termination. Sheets shall be embedded in hot solid-mopped asphalt, applied at a rate of 0.97 to 1.46 kg per square meter. Hot asphalt shall flow out of all side and end laps. End laps shall be back-mopped.

3.10 TERMINATIONS AT PERIMETERS

The modified bitumen membrane shall extend up abutting surface at least 100 mm or 50 mm above the top of the cant.

3.11 MECHANICAL FASTENING

Nails and fasteners for securing base or membrane sheet to wood nailers or deck shall be flush driven through flat metal disks of not less than 25 mm diameter. Metal disks may be omitted where heads of fasteners are equivalent in size to the 25 mm diameter disks. Screw fasteners with disks as specified by the membrane manufacturer shall be used on concrete or metal deck. Nails and fasteners shall be spaced to meet the wind uplift requirement and within the tolerances specified by the manufacturer. Penetration of nails and fasteners will not be permitted through the exposed surface of membrane.

3.12 PROTECTION OF APPLIED ROOFING

At end of day's work or whenever precipitation is imminent, the terminated edge of the roofing shall be sealed with two full width strips of roofing felt set in and coated with bituminous cement or hot mopped asphalt. One

half-width of strips shall be extended up and over the finished roofing and the other half-width extended out and onto the bare roof deck or existing membrane. Sealing strips shall be removed before continuing installation of roofing. To facilitate sealing, termination edges may be straightened with pieces of insulation board which shall be removed when work is resumed.

3.13 FLASHINGS

Flashings shall be provided over cants, in the angles formed at walls and other vertical surfaces, and where required to make the work watertight. Modified bitumen flashings shall be used, except where metal flashings are specified in other sections of the specifications.

3.14 [AM#0001] LOOSE GRANULES

Pour loose mineral granules on excess asphalt at seams. Tamp lightly or gently roll granules into soft asphalt partially imbedding them. Granules shall not be fully imbedded in the asphalt. Cover excess asphalt completely.

3.15 WALKWAYS

Walkways shall be mineral surfaced modified bitumen cap sheet and shall be located as indicated.

3.16 FIRE WATCH

Fire watch shall be provided continuously during and for at least 1 hour following torch application. At least two 9.46 liter containers of water and two 6.8 kg carbon dioxide extinguishers shall be available during the fire watch. When work is interrupted, or at the end of a section of roofing, and at end of each day's work, areas which had been subjected to torch applications shall be surveyed with an infra-red sensing device. Hot spots shall be cooled and re-surveyed. If a hot spot persists, the roof shall be cut open and any smoldering materials shall be extinguished before the foreman leaves the site.

3.17 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roofing with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Inspection shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.

b. Verification of compliance of materials before, during, and after installation.

c. Inspection of condition of equipment and accuracy of thermometers and metering devices.

d. Inspection of flashings, cants and curbs.

e. Inspection of membrane placement, including edge envelopes, widths of starter sheets, laps, proper use of squeegee, and mechanical

fastening.

f. Inspection of application of bitumen, aggregate, and walkways.

h. Cutout sampling and analysis as directed.

-- End of Section --

SECTION 08700

BUILDERS' HARDWARE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen
ASTM F 883	(1990) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA-01	(Effective thru Jun 1998) Directory of Certified Locks & Latches
BHMA-02	(Effective thru Jul 1997) Directory of Certified Door Closers
BHMA-03	(Effective thru Jul 1997) Directory of Certified Exit Devices
BHMA ANSI/BHMA A156.1	(1997) Butts and Hinges
BHMA ANSI/BHMA A156.2	(1996) Bored and Preassembled Locks and Latches
BHMA ANSI/BHMA A156.3	(1994) Exit Devices
BHMA ANSI/BHMA A156.4	(1992) Door Controls - Closers
BHMA ANSI/BHMA A156.5	(1992) Auxiliary Locks & Associated Products
BHMA ANSI/BHMA A156.6	(1994) Architectural Door Trim
BHMA ANSI/BHMA A156.7	(1988) Template Hinge Dimensions
BHMA ANSI/BHMA A156.8	(1994) Door Controls - Overhead Stops and Holders
BHMA ANSI/BHMA A156.13	(1994) Mortise Locks & Latches
BHMA ANSI/BHMA A156.16	(1989) Auxiliary Hardware

BHMA ANSI/BHMA A156.17	(1993) Self Closing Hinges & Pivots
BHMA ANSI/BHMA A156.18	(1993) Materials and Finishes
BHMA ANSI/BHMA A156.20	(1996) Strap and Tee Hinges and Hasps
BHMA ANSI/BHMA A156.21	(1996) Thresholds

DOOR AND HARDWARE INSTITUTE (DHI)

DHI-03	(1989) Keying Systems and Nomenclature
DHI-04	(1976) Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames
DHI 05	(1990) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames
DHI-A115.1G	(1994) Installation Guide for Doors and Hardware
DHI A115-W	(Varies) Wood Door Hardware Standards (Incl All5-W1 thru A115-W9)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1995) Fire Doors and Fire Windows
NFPA 101	(1997; Errata 97-1) Life Safety Code
NFPA 105	(1993) Installation of Smoke-Control Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Hardware and Accessories; GA.

Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions. Spare parts data for locksets, exit devices, closers, electric locks, electric strikes, electro-magnetic closer holder release devices, and electric exit devices, after approval of the detail drawings, and not later than 3 month(s) prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-04 Drawings

Hardware Devices; GA.

Detail drawings for hardware devices for computerized keying systems, ,

keyless push button access control systems, and other electrical hardware devices showing complete wiring and schematic diagrams and other details required to demonstrate proper function of units.

SD-07 Schedules

Hardware Schedule; GA.

Hardware schedule listing all items to be furnished. The schedule shall include for each item: the quantities; manufacturer's name and catalog numbers; the ANSI number specified, sizes; detail information or catalog cuts; finishes; door and frame size and materials; location and hardware set identification cross-references to drawings; corresponding reference standard type number or function number from manufacturer's catalog if not covered by ANSI or BHMA; and list of abbreviations and template numbers.

Keying Schedule; GA.

Keying schedule developed in accordance with DHI-03, after the keying meeting with the user.

SD-13 Certificates

Hardware and Accessories; FIO.

The hardware manufacturer's certificates of compliance stating that the supplied material or hardware item meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of the product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply. A statement that the proposed hardware items appear in BHMA-01, BHMA-02 and BHMA-03 directories of certified products may be submitted in lieu of certificates.

1.3 PREDELIVERY CONFERENCE

Upon approval of the Hardware Schedule, the construction Contractor shall arrange a conference with the hardware supplier, Contracting Officer and the using agency to determine keying system requirements. Location of the key control storage system, set-up and key identification labeling will also be determined.

1.4 DELIVERY, STORAGE, AND HANDLING

Hardware shall be delivered to the project site in the manufacturer's original packages. Each article of hardware shall be individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule. Each change key shall be tagged or otherwise identified with the door for which its cylinder is intended. Where double cylinder functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and on the hardware schedule. Manufacturer's printed installation instructions, fasteners, and special tools shall be included in each package.

1.5 SPECIAL TOOLS

Special tools, such as those supplied by the manufacturer, unique wrenches, and dogging keys, shall be provided as required to adjust hardware items.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

1.7 OPERATION AND MAINTENANCE MANUALS

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides shall be provided. The instructions for electric locks, electric strikes, electro-magnetic closer holder release devices, and electric exit devices shall include simplified diagrams as installed.

1.8 TRAINING

Provide minimum 8 hours on-site training in maintenance and repair of electric and electronic hardware incorporated in project. Provide printed training materials including instructions, routine maintenance procedures, troubleshooting procedures for possible breakdowns, and repairs.

PART 2 PRODUCTS

2.1 GENERAL HARDWARE REQUIREMENTS

Hardware shall conform to the requirements specified herein and the HARDWARE SETS listing at the end of this section. Hardware set numbers correspond to the set numbers shown on the drawings.

2.2 TEMPLATES

Requirements for hardware to be mounted on metal doors or metal frames shall be coordinated between hardware manufacturer and door or frame manufacturer by use of templates and other information to establish location, reinforcement required, size of holes, and similar details. Templates of hinges shall conform to BHMA ANSI/BHMA A156.7.

2.3 HINGES

Hinges shall conform to BHMA ANSI/BHMA A156.1. Hinges used on metal doors and frames shall also conform to BHMA ANSI/BHMA A156.7. Except as otherwise specified, hinge sizes shall conform to the hinge manufacturer's printed recommendations.

2.3.1 Hinges for Reverse Bevel Doors with Locks

Hinges for reverse bevel doors with locks shall have pins that are made nonremovable by means such as a set screw in the barrel, or safety stud, when the door is in the closed position.

2.3.2 Contractor's Option

Hinges with antifriction bearings may be furnished in lieu of ball bearing hinges, except where prohibited for fire doors by the requirements of NFPA 80.

2.3.3 Spring Hinges

Spring hinges shall conform to BHMA ANSI/BHMA A156.17.

2.4 LOCKS AND LATCHES

To the maximum extent possible, locksets, latchsets and deadlocks, and all components thereof, including cylinders and removable cores, shall be the products of a single manufacturer. Strikes for wood frames and pairs of wood doors shall be furnished with wrought boxes.

2.4.1 Mortise Lock and Latchsets

Mortise lock, latchsets, and strikes shall be series 1000 and shall conform to BHMA ANSI/BHMA A156.13, operational Grade 1. Strikes for security doors shall be rectangular without curved lip. Mortise type locks and latches for doors 44 mm thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts.

2.4.2 Bored Lock and Latchsets

Bored lock, latchsets, and strikes shall be series 4000 and shall conform to BHMA ANSI/BHMA A156.2, Grade 1. Bored type locks and latches for doors 35 mm thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door.

2.4.3 Auxiliary Locks and Associated Products

Electric strikes shall conform to BHMA ANSI/BHMA A156.5. Strike boxes shall be furnished with dead bolt and latch strikes for Grade 1. Electric strikes shall be unlocked from a remote location in fail secured mode. Electric strike for rated openings shall be fail secured.

2.4.4 Lock Cylinders (Mortise, Rim and Bored)

Lock cylinders shall comply with BHMA ANSI/BHMA A156.5. Lock cylinder shall have not less than seven pins. Cylinders shall have key removable type cores. An extension of the existing keying system shall be provided for. The cylinders shall be compatible with existing locks that were manufactured by Best Access Systems and have interchangeable cores. Construction interchangeable metal cores shall be provided. Disassembly of knob or lockset shall not be required to remove core from lockset. All locksets, lockable exit devices, and padlocks shall accept same interchangeable cores.

2.4.5 Padlocks

Padlocks shall conform to ASTM F 883. Straps, tee hinges, and hasps shall conform to BHMA ANSI/BHMA A156.20.

2.4.6 Lock Trim

Lock trim shall be cast, forged, or heavy wrought construction of commercial plain design. In addition to meeting the test requirement of BHMA ANSI/BHMA A156.2 or BHMA ANSI/BHMA A156.13, knobs, lever handles, roses, and escutcheons shall be 1.27 mm thick, if unreinforced. If reinforced, the outer shell shall be 0.89 mm thick and the combined thickness shall be 1.78 mm except that knob shanks shall be 1.52 mm thick. Knob diameter shall be 54 to 57 mm. Lever handles shall be of plain design with ends returned to no more than 10 mm from the door face.

2.5 EXIT DEVICES AND EXIT DEVICE ACCESSORIES

Exit devices and exit device accessories shall conform to BHMA ANSI/BHMA A156.3, Grade 1.

2.5.1 Exit Devices and Auxiliary Items

Trim shall be of wrought construction and commercial plain design with straight, beveled, or smoothly rounded sides, corners, and edges. Adjustable strikes shall be provided for rim type and vertical rod devices. Open back strikes shall be provided for pairs of doors with mortise and vertical rod devices; except open back strikes shall be used on labeled doors only where specifically provided for in the published listings. Touch bars shall be provided in lieu of conventional crossbars and arms. Escutcheons shall be provided not less than 175 by 55 mm. Escutcheons shall be cut to suit cylinders and operating trim.

2.6 KEYING

Locks shall be keyed in sets or subsets as scheduled. Locks shall be furnished with the manufacturer's standard construction key system. Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Keys shall be supplied as follows:

Locks:	3 change keys each lock.
Master keyed sets:	6 keys each set.
Grand master keys:	6 total.
Construction keys:	6 total.
Blank keys:	10 total.

The keys shall be furnished to the Contracting Officer arranged in a key cabinet with expansion capabilities for key control system storage in sets or subsets as scheduled.

Bitting List shall be provided by Lock Manufacture (only) with extra expansions to existing master key System for Randolph AFB. This should be received by registered mail to Contracting Officer.

2.7 DOOR CLOSING DEVICES

Door closing devices shall conform to BHMA ANSI/BHMA A156.4, Grade 1. Closing devices shall be products of one manufacturer for each type specified. The opening resistance of closing devices shall not exceed 67 N applied at the latch stile or exceed 22 N where low opening resistance is scheduled.

2.7.1 Surface Type Closers

Surface type closers shall be Grade 1, Series C02000 Standard Cover with options PT-4H, Size 1 or 2 through Size 6, and PT-4D with back check position valve. Except as otherwise specified, sizes shall conform to the manufacturer's published recommendations. Closers for outswinging exterior doors shall have parallel arms or shall be top jamb mounted. Closers for doors close to a wall shall be of narrow projection so as not to strike the wall at the 90-degree open position.

2.8 DOOR CONTROLS - OVERHEAD HOLDERS

Door controls - overhead holders shall conform to BHMA ANSI/BHMA A156.8.

2.9 ARCHITECTURAL DOOR TRIM

Architectural door trim shall conform to BHMA ANSI/BHMA A156.6.

2.9.1 Door Protection Plates

2.9.1.1 Kick Plates

Kick plates shall be Type J102 stainless steel. Width of plates shall be 50 mm less than door width for single doors and 25 mm less for pairs of doors. Height shall be 400 mm, except where the bottom rail is less than 400 mm the plate shall extend to within 13 mm of the panel mold or glass bead. Edges of metal plates shall be beveled.

2.10 AUXILIARY HARDWARE

Auxiliary hardware, consisting of door holders, door stops, and viewers, shall conform to BHMA ANSI/BHMA A156.16.

2.11 MISCELLANEOUS

2.11.1 Automatic Door Bottoms

Automatic door bottoms shall be surface type with aluminum housing cover, anodized clear finish. Door bottom shall have a wool, felt, rubber, vinyl, or neoprene seal and shall be actuated by the opening and closing of the door. The door bottom shall exclude light when the door is in the closed position and shall inhibit the flow of air through the unit.

2.11.2 Metal Thresholds

Thresholds shall conform to BHMA ANSI/BHMA A156.21. Thresholds for exterior doors shall be extruded aluminum of the type indicated and shall provide proper clearance and an effective seal with specified weather stripping. Where required, thresholds shall be modified to receive projecting bolts of flush bolts . Air leakage rate of weatherstripping shall not exceed 0.775 liters per second per lineal meter of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.11.3 Rain Drips

Extruded aluminum, not less than 1.78 mm thick, bronze anodized. Overhead rain drips shall be approximately 38 mm high by 63 mm projection and shall extend 50 mm on either side of the door opening width.

2.11.4 Gasketing

Gasketing shall be a compression type seal, silicon based, self-adhesive product for use on steel door frames with wood and steel doors for 1-1/2 hour B-label. Color shall be bronze. Air leakage rate of weatherstripping shall not exceed 0.775 liters per second per lineal meter of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.11.5 Door Stops

Wall stops, floor stops and combination stop and holders shall conform to BHMA ANSI/BHMA A156.16.

2.12 FASTENINGS

Fastenings of proper type, size, quantity, and finish shall be supplied with each article of hardware. Machine screws and expansion shields shall be used for attaching hardware to concrete or masonry. Fastenings exposed to the weather in the finished work shall be of brass, bronze, or stainless steel. Sex bolts, through bolts, or machine screws and grommet nuts, where used on reverse-bevel exterior doors equipped with half-surface or full-surface hinges, shall employ one-way screws or other approved tamperproof screws. Screws for the jamb leaf of half-mortise and full-surface hinges attached to structural steel frames shall be one-way or other approved tamperproof type.

2.13 FINISHES

Unless otherwise specified, finishes shall conform to those identified in BHMA ANSI/BHMA A156.18. Where painting of primed surfaces is required, painting is specified in Section 09900 PAINTING, GENERAL.

Lock and door trim finishes shall generally be the following types:

Locksets, closers, exit devices, stops, holders, flush bolts, etc. shall be dull stain chrome or brushed aluminum

Hinges, kickplates, push plates, pulls shall be brushed stainless..

2.14 HARDWARE FOR FIRE DOORS

Hardware for fire doors shall conform to the requirements of NFPA 80and NFPA 101.

PART 3 EXECUTION

3.1 APPLICATION

Hardware shall be located in accordance with DHI-04 and DHI 05, except that deadlocks shall be mounted 1220 mm above finish floor. When approved, slight variations in locations or dimensions will be permitted. Application shall be in accordance with DHI-A115.1G or DHI A115-W. Door control devices for exterior doors such as closers and holders, shall be attached to doors with thru bolts and nuts or sex bolts. Alternate fastening methods may be approved by the Contracting Officer when manufacturers' documentation is submitted to verify that the fastening devices and door reinforcements are adequate to resist wind induced stresses. Electric hardware items and access control devices shall be installed in accordance with manufacturer's printed installation procedures.

3.1.1 Hardware for Fire Doors and Smoke-Control Door Assemblies

Hardware for fire doors shall be installed in accordance with the requirements of NFPA 80. Exit devices installed on fire doors shall have a visible label bearing the marking "Fire Exit Hardware". Other hardware installed on fire doors, such as locksets, closers, and hinges shall have a visible label or stamp indicating that the hardware items have been approved by an approved testing agency for installation on fire-rated doors. Hardware for smoke-control door assemblies shall be installed in accordance with NFPA 105.

3.1.2 Door-Closing Devices

Door-closing devices shall be installed and adjusted in accordance with the templates and printed instructions supplied by the manufacturer of the devices. Insofar as practicable, doors opening to or from halls and corridors shall have the closer mounted on the room side of the door.

3.1.3 Kick Plates

Kick plates shall be installed on the push side of single-acting doors.

3.1.4 Auxiliary Hardware

Lever extension flush bolts shall be installed at the top and bottom of the inactive leaf of pairs of doors. The bottom bolt shall operate into a dust-proof floor strike or threshold.

3.1.5 Thresholds

Thresholds shall be secured with a minimum of three fasteners per single door width and six fasteners per double door width with a maximum spacing of 300 mm. Exterior thresholds shall be installed in a bed of sealant with expansion anchors and stainless steel screws, except that bronze or anodized bronze thresholds shall be installed with expansion anchors with brass screws. Minimum screw size shall be No. 10 length, dependent on job conditions, with a minimum of 19 mm thread engagement into the floor or anchoring device used.

3.1.6 Rain Drips

Overhead rain drips shall align with bottom edge of door frame rabbet. Drips shall be set in sealant and fastened with stainless steel screws.

3.1.7 Weatherseals

Weatherseals shall be located as indicated, snug to door face and fastened in place with color matched metal screws after door and frames have been finish painted. Screw spacing shall be as recommended by manufacturer.

3.1.8 Gasketing

Gasketing shall be installed at the inside edge of the hinge and head and latch sides of door frame. Frames shall be toleranced for a 3 mm clearance between door and frame. Frames shall be treated with tape primer prior to installation.

3.2 OPERATIONAL TESTS

Prior to acceptance of any electrical hardware system, an operational test shall be performed to determine if devices are operating as intended by the specifications. Wiring shall be tested for correct voltage, current carrying capacity, and proper grounding. Stray voltages in lock wiring shall be eliminated to prevent locking devices from releasing in critical situations.

3.3 FIELD QUALITY CONTROL

Architectural Hardware Consultant employed by the Supplier shall inspect the completed installation and certify that the hardware has been furnished and installed in accordance with the manufacturers' instructions and as

specified. The inspection report shall identify any malfunctioning items and recommend adjustment or replacement as appropriate.

3.4 HARDWARE SETS

HW-1

EACH TO HAVE:

	3	EA	BUTTS	A2112 4-1/2 X 4-1/2 NRP
(S)	1	EA	LOCK	F86
	1	EA	ELECTRIC STRIKE	E09321
	1	EA	VIEWER	L03221
	1	EA	CLOSER	C02021
	1	EA	KICK PLATE	J102
	1	EA	STOP	L02121
(N)	1	EA	THRESHOLD	424
(N)	1	EA	DOOR BOTTOM	200N
(N)	1	ST	WEATHERSTRIPPING	5050

HW-2

EACH TO HAVE:

	3	EA	BUTTS	A2112 4-1/2 X 4-1/2 NRP
	1	EA	PANIC DEVICE	TYPE 1 FUNCTION 01
	1	EA	CLOSER	C02021
	1	EA	KICK PLATE	J102
	1	EA	STOP	L02121
(N)	1	EA	THRESHOLD	424
(N)	1	EA	DOOR BOTTOM	200N
(N)	1	ST	WEATHERSTRIPPING	5050

HW-3

EACH TO HAVE:

	3	EA	BUTTS	A2112 4-1/2 X 4-1/2 NRP
	1	EA	LOCK	F17
	(N) 1	EA	RAIN DRIP	16DKB
(N)	1	EA	THRESHOLD	424
(N)	1	EA	DOOR BOTTOM	200N
(N)	1	ST	WEATHERSTRIPPING	5050

HW-4

EACH TO HAVE:

	3	EA	BUTTS	A2133 4-1/2 X 4-1/2 NRP
	1	EA	LOCK	F17
	1	EA	O.H. STOPS	C02511
(N)	1	EA	THRESHOLD	424
(N)	1	EA	DOOR BOTTOM	200N
(N)	1	ST	GASKETING	5050

HW-5

GATE AT MECHANICAL YARD

TO HAVE:

(B)	1	EA	PADLOCK	11B722LM3

- BALANCE OF HARDWARE BY GATE SUPPLIER -

HW-6

EACH TO HAVE:

	3	EA	BUTTS	A8112 4-1/2 X 4-1/2
	1	EA	LOCK	F84
	1	EA	CLOSER	C02011
	1	EA	KICK PLATE	J102
	1	EA	STOP	LO2101
(N)	1	EA	AUTO DOOR BOTTOM	220
(N)	1	ST	GASKETING	5050

HW-7

EACH TO HAVE:

	3	EA	BUTTS	A8112 4-1/2 X 4-1/2
	1	EA	LOCK	F84; [AM#0001]
	1	EA	CLOSER	C02011
	1	EA	KICK PLATE	J102
	1	EA	STOP	LO2101

HW-8

EACH TO HAVE:

	3	EA	BUTTS	A8112 4-1/2 X 4-1/2
	1	EA	LOCK	F21
	1	EA	CLOSER	C02011
	1	EA	KICK PLATE	J102
	1	EA	STOP	LO2101

HW-9

	3	EA	BUTTS	A8112 4-1/2 X 4-1/2
	1	EA	LOCK	F82
	1	EA	CLOSER	C02011
	1	EA	KICK PLATE	J102
	1	EA	STOP	LO2101

HW-10 NOT USED

HW-11 NOT USED

HW-12

EACH TO HAVE:

	3	EA	BUTTS	A8112 4-1/2 X 4-1/2
	1	EA	PRIVACY LOCK	F76
	1	EA	CLOSER	C02011
	1	EA	KICK PLATE	J102
	1	EA	STOP	LO2101

HW-13

EACH TO HAVE:

	3	EA	BUTTS	A8112 4-1/2 X 4-1/2
	1	EA	PASSAGE SET	F75
	1	EA	CLOSER	C02051
	1	EA	KICK PLATE	J102
	1	EA	STOP	LO2101

HW-14

	3	EA	BUTTS	A8112 4-1/2 X 4-1/2
	1	EA	LOCK	F86
	1	EA	ELECTRIC STRIKE	E09321
	1	EA	VIEWER	L03221
	1	EA	CLOSER	C02011
	1	EA	KICK PLATE	J102
	1	EA	STOP	LO2101
(N)	1	EA	AUTO DOOR BOTTOM	220
(N)	1	ST	GASKETING	5050

-- End of Section --

SECTION 14240

ELEVATORS, HYDRAULIC

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1998) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1997a) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 176	(1997) Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 366/A 366M	(1997) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 568/A 568M	(1998) Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A 569/A 569M	(1997) Commercial Steel (CS) Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled
ASTM D 92	(1997) Flash and Fire Points by Cleveland Open Cup (IP 36/84 (89)
ASTM E 84	(1998el) Surface Burning Characteristics of Building Materials

ASME INTERNATIONAL (ASME)

ASME A17.1	(1998a) Safety Code for Elevators and Escalators
ASME A17.2.2	(1994) Inspectors' Manual for Hydraulic Elevators
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B31.1	(1998) Power Piping
ASME QEI-1	(1997) Standard for the Qualification of Elevator Inspectors

CODE OF FEDERAL REGULATIONS (CFR)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities

FEDERAL STANDARDS (FED-STD)

FED-STD 795	(Basic) Uniform Federal Accessibility Standards

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(1995) High-Pressure Decorative Laminates
NEMA MG 1	(1993; Rev 1; Rev 2; Rev 3; Rev 4) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 252	(1995) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation. Submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Training Data; FIO.

Information describing the training course for operating personnel, training aids and samples of materials to be used, training schedules, and notification of training.

Elevator System; FIO.

A complete list of equipment and material, including illustrations, schedules, manufacturer's descriptive data and technical literature, performance charts, catalog cuts, installation instructions, brochures, diagrams, and other information required for fabrication and installation of the equipment. Data shall include calculations for reaction loads imposed on building by elevator systems. Certified copies of list reports may be submitted in lieu of calculations. Calculations to demonstrate compliance with ASME A17.1, Rule XXIV shall be included. Spare parts data for each different item of material and equipment specified, after approval of detail drawings and not later than four weeks prior to date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended to be replaced and replacement interval required. Data shall include appropriate sizing of electrical protective devices.

SD-04 Drawings

Elevator System; FIO.

Detail drawings including dimensioned layouts in plan and elevation showing the arrangement of elevator equipment, anchorage of equipment, clearances for maintenance and operation; and details on hoistway, doors and frames, operation and signal stations, controllers, motors, guide rails and brackets, cylinder and plunge unit, and points of interface with normal power fire alarm system . Drawings shall show any revised building electrical system required to make supplied elevator system function as specified. Drawings shall contain complete wiring diagrams showing electrical connections and other details required to demonstrate sequence of operation and functions of system devices. Drawings shall include the appropriate sizing of electrical protective devices which are frequently different from National Electrical Code standard sizes.

SD-06 Instructions

Framed Instructions; FIO.

Diagrams, instructions, and other sheets proposed for posting.

SD-08 Statements

Qualification Certificates; FIO.

Certificates of experience of elevator mechanics employed to install, supervise and test the elevator shall certify mechanics to have not less than 5 years experience installing, supervising and testing elevators of the type and rating specified. Certificate shall certify that elevator system installer is acceptable to elevator manufacturer prior to installation of elevators.

SD-09 Reports

Testing; FIO.

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of installed system.

SD-14 Samples

Finishes; FIO.

Samples of materials and products requiring color or finish selection.

SD-18 Records

Test Procedures; GA

A plan detailing the testing procedures shall be submitted 60 days prior to performing the elevator tests.

SD-19 Operation and Maintenance Manuals

Elevator System; GA.

Six copies of operation manual outlining the step-by-step procedures for system startup, operation and shutdown. Manuals shall include

manufacturer's name, model number, service manual, parts list and brief description of all equipment, including basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Manuals shall include equipment layout and complete wiring and control diagrams of the system as installed. Operation and maintenance manuals shall be approved prior to training course.

1.3 QUALIFICATIONS

Hydraulic elevators shall be pre-engineered elevator systems, and provided by a company regularly engaged in the manufacture of elevator systems. The manufacturer shall either install the elevator system or provide letter of endorsement certifying that the elevator-system installer is acceptable to the manufacturer.

1.4 REGULATORY REQUIREMENTS

Design and fabrication shall be in accordance with ASME A17.1. Each car shall have the capacity to lift a live load, exclusive of the car, at a speed as specified in the following schedule. The approximate travel, terminal floors, number of stops and openings, and the car sizes shall be as shown in the schedule. The elevators shall serve the floors with stops and openings in accordance with the requirements indicated. Elevators shall provide accessibility and usability for physically handicapped in accordance with the requirements for the handicapped in FED-STD 795 and 36 CFR 1191.

1.4.1 Elevator Schedule (Passenger)

Number of Elevators Required:	ONE
Service:	Passenger
Capacity:	1,134 kg kg (2,500 pounds)
Speed:	1.02 m/s (fpm) (full load up) (0.75 m/s (150 fpm) downspeed)
Clear Car Inside:	2032 wide by 1447 deep
Net Travel:	16000
Landings:	5
Openings: Front	5
Entrance Type:	Horizontal-sliding

1.5 DESIGNATED LANDING

For the purposes of firefighter's service and emergency operations, as required by Section 211, ASME A17.1, the designated landing or level shall

be the first floor. The alternate landing or level shall be the second floor.

1.6 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity and excessive temperature variations; and dirt, or other contaminants.

1.7 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and advise the Contracting Officer of any discrepancy before performing any work.

1.8 WARRANTY

Warranty service shall be provided for each elevator for a period of 12 months after date of acceptance by Contracting Officer. Warranty service shall be performed only by trained elevator mechanics during regular working hours and shall include manufacturer's warranty requirements including but not limited to adjusting, lubricating and cleaning of equipment and furnishing supplies and parts to keep elevator in operation, except such parts made necessary by misuse, accident or negligence not caused by the Contractor. Testing and adjustments shall be in accordance with the applicable provisions of ASME A17.1 and ASME A17.2.2. Emergency callback service shall be included and available 24 hours a day, 7 days per week, with an initial telephone response time of 1 hour and a response time of 4 hours for a mechanic to the site. Inspection and service for fire service operation shall be performed every 6 months. Documentation of inspection and testing, and certification of successful operation shall be provided with each unit.

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

2.1.1 Standard Products

Material and equipment shall be the standard products of manufacturers regularly engaged in the fabrication of elevators and/or elevator parts, and shall essentially duplicate items which have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is available 24 hours a day, 7 days per week, with a response time of 4 hours.

2.1.2 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, and electrical and mechanical characteristics on a plate secured to the item of equipment.

2.1.3 Special Tools

One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment shall be provided.

2.1.4 Electrical Work

Changes to the electrical distribution system required for coordination with elevator equipment shall be performed and coordinated by Contractor, at Contractor's expense. Electrical service for elevator machines shall be 208 volt, 60-Hertz, 3-phase, 4 wire solid neutral grounded alternating current. Electric service for elevator car lighting shall be 120-volt, single-phase, 60-Hertz grounded service. Electrical work shall conform to requirements in Section 16415 ELECTRICAL WORK, INTERIOR. A disconnect switch that will shut off power to the elevator car lighting shall be provided in the elevator machine room adjacent to the elevator control panel. A telephone junction box and an elevator car lighting junction box shall be provided adjacent to each controller. A single-phase electric circuit with grounded connection for video monitor shall be provided in machine room.

2.1.5 Use of Asbestos Products

Materials and products required for manufacturing and installing elevators shall not contain asbestos.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Materials for Car Enclosures

Materials for car enclosures shall meet flame spread rating 0 to 75 and smoke development 0 to 450 as tested in accordance with requirements of ASTM E 84 as established by ASME A17.1, Rule 204.2.

2.2.2 Structural Steel

Structural steel shall be hot-rolled commercial quality carbon steel, pickled, oiled, complying with ASTM A 569/A 569M and ASTM A 568/A 568M.

2.2.3 Cold-Rolled Sheet Steel

Sheet steel shall be cold-rolled commercial quality low carbon steel, Class 1, exposed matte finish, oiled, complying with ASTM A 366/A 366M and ASTM A 568/A 568M.

2.2.4 Stainless Steel

Stainless steel shall be ASTM A 176 Type 302/304, austenitic, corrosion-resistant, with grain of belting in the direction of longest dimension. Surfaces shall be smooth and without waves and shall be in compliance with ASTM A 366/A 366M.

2.3 PASSENGER ELEVATOR CAR

2.3.1 Car Fronts

Fronts for passenger elevators shall be combination door post and return panels manufactured of 1.9837 mm thick (14 gauge) stainless steel provided with necessary cutouts for operating devices. Car operating panel shall be recessed into front return panel with surface-applied operating panel cover. Position indicator in front return shall be recessed with a surface-applied cover plate. Exposed stainless steel shall be finished with No. 4 Satin Finish, unless otherwise specified.

2.3.2 Car Doors

Car doors for passenger elevators shall be constructed from 1.519 mm thick (16 gauge) sheet steel and stainless steel cladding. Each door shall be sound-deadened and reinforced to receive required operating mechanism and hardware, and have two removable door guides per panel. Seams, screws or binding strips shall not be visible from within the car. Threshold shall be extruded aluminum with grooves for door guides. Exposed steel shall be finished with rust-inhibitive primer and baked-enamel in a color to be selected, unless otherwise specified. Car doors shall be equipped with a proximity-type infrared protective device having the following operation:

a. When doors are in full-open position, doors shall be unable to initiate closing if a person comes within detection zone. Detection zone moves with doors, so that if a passenger or object enters the zone after doors have begun to close, doors shall stop, then reverse to reopen. Doors shall reclose after a brief time. A passenger entering or leaving cars shall not cause doors to reopen unless doors reach a predetermined proximity to passenger.

b. After a stop is made, doors shall remain open for a time to permit passenger transfer, after which doors shall close automatically. This time interval shall be less for a car call than for a hall call or a coincident car/hall call.

c. If there is either a hall call anywhere in the group or a car call in the car in question and doors are prevented from closing for a fixed time period, door protective device shall be rendered inoperative, a buzzer shall sound in car and doors shall close at approximately half speed. Normal door operation shall resume at next landing reached by car.

2.3.3 Car Platform

Car platform for passenger elevators shall be fabricated from steel plates secured to a steel frame or plywood secured to a steel frame. Steel car platforms shall be assembled into a one-piece platform with top and bottom steel plates welded to structural steel frame and covered with felt and sound-isolation. Plywood car platform shall be 18 mm (3/4 inch) thick Exposure 1 plywood secured to underside of structural steel frame with metal fire protection secured to underside of structural steel frame.

2.3.4 Sling

Sling for passenger elevators shall be constructed of heavy steel stiles properly affixed to a steel crosshead and bolster with adequate bracing members to remove all strain from car enclosure. Steel bumpers shall be furnished for fastening sling to plunger.

2.3.5 Walls

Walls for passenger elevators shall be 2426 mm (7 feet 11-1/2 inches) high from floor to the underside of lighting fixtures. Side and rear panels shall be 1.519 mm thick (16 gauge) sheet steel panels. Side and rear removable panels shall be applied to car walls and shall be manufactured from 18 mm (3/4 inch) plywood or composition board finished on front, back and edges faced with plastic laminate conforming to NEMA LD 3, general purpose type. Panels shall be mounted on car walls in a manner permitting their reversing. Panels shall be evenly spaced with not less than two panels on each side and three panels at rear with reveal standard with manufacturer. Vent around base shall be concealed behind removable panels.

2.3.6 Car Top, Ceiling and Light Fixtures

Car top for passenger elevators shall be manufactured from 2.657 mm thick (12 gauge) sheet steel and shall be not less than 140 mm high with drop-ceiling and light fixtures. Ceiling shall be egg crate white plastic fire-retardant light diffuser supported by polished aluminum perimeter frame and dividers to form drop-ceiling light fixture. Light fixtures shall be fluorescent type flush with car ceiling, manufactured of sheet steel with flange and enclosed sides and top, baked-enamel reflector, mounted directly to outlet box. Bottom of fixtures shall be flush with car ceiling. Fluorescent light fixtures shall be dual lamp with quick-starting high-power factor, Class P ballasts with safety lamp guard clamps on fluorescent tubes. Light level shall average at least 108 lx (10 footcandles) measured at the car threshold, with the door closed. A part of car light fixture shall be removable to permit use of the emergency exit panel in top of car.

2.3.7 Emergency Exit

Car top for passenger elevators shall be manufactured with a hinged emergency exit panel of 2.657 mm thick (12 gauge) steel which opens up to clear the crosshead and car door operator. Emergency exit panel shall be hinged on counterweight side and held in place with nonremovable fastening devices at each corner, and be openable from top of car only. A minimum of two sides of exit panel shall lap exit opening by 25 mm. Exits shall be equipped with electrical contacts which will prevent operation of car when the exit door is open and cause the alarm bell to ring.

2.3.8 Floor Finish

Floor finish for passenger elevators shall be finished with resilient tile flooring not less than 5 mm (3/16 inch) thick or flexible type homogeneous vinyl tile not less than 3 mm (1/8 inch) thick as specified in Section 09650 RESILIENT FLOORING. Tile shall be laid flush with the extruded aluminum platform threshold.

2.3.9 Base

Base for passenger elevators shall be cove type stainless steel, 150 mm (6 inches) high.

2.3.10 Handrails

Handrails for passenger elevators shall be mounted on each wall and shall comply with ASME A17.1, FED-STD 795 and 36 CFR 1191. For elevators with two-speed horizontal-slide openings, handrails shall be turned back to wall.

2.3.11 Exhaust Fan

Exhaust fan for passenger elevators shall be two-speed exhaust type ventilating unit mounted in car ceiling and shall be provided with a stainless steel grille. Units shall be suitably isolated from car ceiling and shall provide at top speed of a minimum of 6 air changes per hour for car volume and car occupancy. Switches for the operation of the exhaust unit shall be located in car station locked cabinet or key-switched.

2.3.12 Communications

A telephone system in stainless steel cabinets shall be provided for passenger elevators. A vandal-resistant speaker type intercom with push-buttons to activate shall be installed in car station behind a stainless steel perforated grille and connected to a programmable auto-dialer located in machine room. Auto-dialer shall be provided with a solid-state charger unit which will automatically provide emergency power and an immediate transfer in the event of failure of normal power supply. The push-button located in car station or in separate cabinet shall be at the prescribed handicapped height and shall be identified as "EMERGENCY PHONE PUSH TO ACTIVATE". The entire communication assembly shall be approved for an elevator installation. The push button telephone shall comply with FED-STD 795 and 36 CFR 1191. The telephone communication shall not be terminated until one of the communicating parties hangs up the receiver or manually disconnects the communication link.

2.3.13 Car Emergency Lighting System

Emergency car lighting system for passenger elevators shall consist of an emergency power pack on top of the elevator and a remote lighting fixture inside elevator car located above car operating panel.

2.3.13.1 Power Pack

Power pack for emergency lighting system shall be a sealed lead-cadmium or nickel-cadmium 6-volt rechargeable batteries with solid-state controls and an integral regulating charger connected to normal power supply. Power pack unit shall contain the following:

a. Minimum 150 mm (6 inch) diameter alarm bell connected to the elevator alarm and emergency push-button.

b. Top of car light fixture with protective wire guard.

c. Testing circuit and pilot light.

d. Low-wattage pilot light indicator.

e. Battery low-voltage disconnect.

2.3.13.2 Emergency Light Fixture

Emergency light fixture shall be located in car station inside elevator car, with flush-mounted lens and shall consist of the following:

a. A minimum of two lamps capable of providing a minimum level of illumination of 10.8 lx (1.0 footcandle) at a point 1220 mm (4 feet) above the floor, 300 mm (1 foot) in front of car station.

b. Steel fixture frame with stainless steel finish.

c. Frosted acrylic lens, 6 mm (1/4 inch).

2.3.13.3 Remote Light Fixture

Upon interruption of normal power, remote light fixture for passenger elevators shall automatically and immediately illuminate and permit operation of alarm bell, subject to activation of emergency stop-switch or alarm button. Emergency power pack shall be capable of providing a minimum of 1 hour emergency bell operation and 4 hours of continuous illumination.

2.3.14 Protection Pads

Car shall be provided with wall protection pads with inconspicuous stainless steel pad hooks spaced not over 460 mm apart near the ceiling. Pads shall be heavy-quality fire-retardant treated canvas with two layers of sewn cotton batting with metal eyelets for each pad hook. Pads shall cover entire wall surface except operating devices.

2.3.15 Certificate Frame

A stainless steel certificate frame with translucent plexiglass lens of the appropriate size to receive certificate issued by inspecting agency shall be provided. Frame shall be engraved to show name of manufacturer, carrying capacity in kilograms (pounds) and maximum number of persons allowed.

2.3.16 Car Guide Shoes

Guide shoes for passenger elevators shall be the adjustable mounting type on each side of car. Shoes shall be rigidly secured in accurate alignment at top and bottom of car frame. Flexible type sliding guide shoes shall consist of a swivel-type shoe, assembled on a metal base with provisions for self-alignment. Each shoe shall be provided with renewable gibs. Car guide shoes shall be adjustable for side play between guide rails. Renewable wearing gibs shall be fabricated from a durable plastic compound material having a low coefficient of friction and long wearing qualities. Gibs shall be the type requiring minimum rail lubrication.

2.4 PASSENGER ELEVATOR HOISTWAY ENTRANCES

2.4.1 Hoistway Doors

Hoistway doors for passenger elevators shall be designed and fabricated as part of a Class B 1-1/2 Hour fire-rated door/frame assembly to meet requirements of NFPA 252 and shall bear the label of an approved testing laboratory. Doors for passenger elevators shall be hollow metal type with plain panel design not less than 32 mm (1-1/4 inches) thick with 1.519 mm thick (16 gauge) face sheet-steel panels, and stainless steel cladding, with 1.519 mm thick (16 gauge) sight guards to match door finish. Each door shall be reinforced with continuous vertical members and filled with sound-deadening material. Doors shall be reinforced to accept the required operating mechanism and hardware. Doors shall have two removable door guides per panel. Seams, binding strips or screws shall not be visible from the landing. Exposed steel shall be finished with rust-inhibitive primer and baked-enamel in a color to be selected, unless otherwise specified. .

2.4.2 Hoistway Frames

Hoistway frames for passenger elevators shall be designed and fabricated as part of a Class B 1-1/2 Hour fire-rated door/frame assembly to meet requirements of NFPA 252 and shall bear the label of an approved testing laboratory. Frames shall be formed 1.897 mm thick (14 gauge) sheet-steel with head and jamb in flush alignment and corners welded and ground smooth. Head and jamb section shall be bolted assembly with bolts, washer and locking nut or lock washer. Frame assembly shall be securely fastened to the structure. Frames shall return to the wall. Combination buck and jamb frames may be provided with knockdown back flanges to permit installation

in concrete walls. Exposed steel shall be finished with rust-inhibitive primer and baked-enamel in a color to be selected, unless otherwise specified.

2.4.3 Symbols

Raised stainless steel symbols as required by FED-STD 795 and 36 CFR 1191 of color selected, shall be provided at each floor to indicate the floor location. Symbols shall be attached with concealed fasteners. Symbols shall be placed in a location which can be seen by passenger from the opened passenger elevator doors.

2.4.4 Sills

Sills for passenger elevators shall be extruded aluminum with slip-resistant surface and machined grooves for door guides, secured to floor beams.

2.4.5 Strut Angles

Strut angles for passenger elevators shall be structural steel of size not less than 76 x 76 x 5 mm (3 x 3 x 3/16 inch) extending from sill to beam above and anchored to building structure with structural steel fastenings and bracings of structural members with a cross section of not less than strut angles.

2.4.6 Door Hangers and Housing

Each door panel shall be provided with not less than two sheave-type hangers designed for required door operation. Hanger housing and support shall be fabricated from formed Z-shaped steel angles of size not less than 5 mm (3/16 inch) thick bolted to strut angles.

2.4.7 Door Rollers

Door rollers shall be constructed with grease-packed ball-bearings and shall be tired with a sound-reducing material. Diameter of rollers shall not be less than 83 mm (3-1/4 inches) for car doors and not less than 57 mm (2-1/4 inches) for hoistway doors. Upward thrust shall be taken by a hardened and ground ball-bearing roller assembled on an eccentric stud to provide adjustment.

2.4.8 Hanger Track

Hanger track shall be of high carbon cold-drawn steel, round at top to receive door rollers, round at bottom to receive up-thrust rollers, of size engineered to accommodate load requirements.

2.4.9 Covers and Guards

Hanger covers, dust covers, toe guards and fascia plate shall be fabricated from 1.519 mm thick (16 gauge) reinforced steel and finished with baked-enamel. Hanger covers shall extend the full door travel and shall be mounted in sections for ease of servicing door hangers. Dust covers shall be provided over top terminal landing door only and shall be secured to hanger housing and building structure. Toe guards shall be secured to sill. Fascia plates shall be provided between each door hanger housing and sill.

2.5 PASSENGER ELEVATOR DOOR OPERATION

Car and hoistway doors for passenger elevators shall be operated simultaneously by an electric-power door operator. Doors shall operate smoothly in the opening direction and closing direction and be electrically cushioned to stop at both the full-open and full-closed position. Operators shall be high-speed heavy-duty type which will provide an average door-opening speed of 0.76 m/s (2-1/2 fps). Car and hoistway doors shall be opened and closed simultaneously in a maximum time of 2.9 seconds. When on automatic operation door-closing time shall not exceed 4.1 seconds and door-closing force shall not exceed 130 N (30 pounds). Reversal of doors when closing shall be accomplished by the "DOOR OPEN" button, car door safety edge, or interruption of the photoelectric light beams. Doors shall be arranged so that doors can be opened manually in the event of power failure.

2.6 PASSENGER ELEVATOR OPERATING AND SIGNAL FIXTURES

2.6.1 General

Elevator fixtures and panels for passenger elevators shall be constructed of 3 mm (1/8 inch) thick faceplates of stainless steel. Fastenings for all exposed fixtures shall be secured with tamper-proof spanner-head screws of same material and finish as fixture. Hall and car call-buttons shall be the call-register type with a low-voltage power supply not to exceed 48 volts. Pressure on a button shall illuminate button to indicate that a call in the desired direction has been registered. Car and hall fixtures shall be designed and located at the prescribed height to accommodate the handicapped in accordance with FED-STD 795 and 36 CFR 1191 for passenger elevators only. Handicapped markings shall be integral with faceplates in accordance with FED-STD 795 and 36 CFR 1191. Surface-applied markings are not acceptable. Engraving shall be black-filled except for fire-service identification which shall be red-filled. Operating and signal fixture contacts and lamps shall be completely enclosed in steel boxes finished with a baked-enamel. Boxes for hall landing devices shall be equipped for proper adjustment to wall. Lamps shall be installed in light-tight compartments. Cover-plates shall be provided with rubber gaskets when exposed to weather or harmful contaminants. Replacement bulbs shall be readily available from three sources.

2.6.2 Car Operating Panel

Car operating panel for passenger elevators shall be provided with the necessary raised (0.8 mm (0.03 inch)) markings for the handicapped, and shall include a series of minimum 20 mm (3/4 inch) diameter push-buttons numbered to correspond to the floor served and various additional switches, buttons and light jewels, including emergency stop, alarm button, "DOOR OPEN" button and communication speaker . Operating buttons shall be vandal-resistant metal encased and embossed to permit illumination when a call is registered. Buttons shall be designed with 0.8 mm (1/32 inch) operating clearance to set on faceplate in lieu of the button mechanism. Buttons shall have maximum protrusion of 5 mm (3/16 inch) beyond the faceplate and shall have beveled edges to prevent damage from side blows. Buttons and switches not required for automatic or fire-service operation shall be key-operated and mounted on front-return car operating station. Elevator number and "NO SMOKING" shall be international symbol engraved on upper portion of car. Operating panel in car shall consist of a flush-mounted panel containing the following operating devices:

a. "DOOR OPEN" button.

b. "DOOR CLOSE" button.

c. Key-operated car fan/light switch.

d. Key-operated ventilating blower switch/call light.

e. Communication speaker phone, grille and push-to-call button .

f. Emergency stop-switch when operated will stop the car independently of normal stopping devices. Operation of emergency stop switch shall not cause any power variance or surge that may affect the operation or condition of the control panel or its components.

g. Emergency signal-switch connected to a 150 mm (6 inch) diameter signal bell outside of elevator hoistway at first floor located as shown or as directed.

h. [AM#0001]_____.

i. Key-operated inspection switch which will render normal operation inoperative for the purpose of using the hoistway access switch.

j. Key-operated fire-service switch and light jewel.

k. [AM#0001]_____.

2.6.3 Auxiliary Car Operating Panel

Auxiliary car operating panel for passenger elevators shall be similar in design to main car panel, and shall include all devices necessary for automatic operation such as emergency stop switch, alarm bell, "DOOR OPEN" button.

2.6.4 Hall-Call Station

Hall-call operating devices for passenger elevators at landing shall consist of an "UP" push-button at bottom landing, a "DOWN" push-button at top landing, and "UP" and "DOWN" push-buttons at all other landings. Buttons shall be vandal-resistant metal encased and back-lighted to permit illumination when a call is registered. Buttons shall be designed with 0.8 mm (1/32 inch) operating clearance to seat on faceplate in lieu of button mechanism. Buttons shall have maximum protrusion of 5 mm (3/16 inch) beyond faceplate with beveled edges to prevent damage from side blows.

2.6.4.1 Commandeering Switch

Key-operated commandeering switch for passenger elevators shall be provided at each landing and located in landing call-button cover plate. Switch shall be momentary pressure type with the key removable only in "Off" position and shall be keyed to match the independent operation switch specified for car operating devices.

2.6.4.2 Fire-Service Switch

Fire-service switch for passenger elevators shall be located at the designated landing.

2.6.5 Direction Lanterns

Lanterns for passenger elevators shall be in accordance with FED-STD 795 and 36 CFR 1191 and shall be provided at all floor landings and in each car entrance column. Lanterns shall be vandal-resistant design.

2.6.6 In-Car Car-Position Indicator

Indicator numerals and directional arrows for passenger elevators shall be flush-mounted faceplate with black-filled engraved numerals not less than 25 mm (1 inch) high and 10 mm (3/8 inch) diameter vandal-resistant light jewels directly beneath each number. As car travels through hoistway the car position shall be indicated by illumination of light jewel corresponding to landing at which the car is stopped or passing. Necessary light baffles shall be provided. Floor numerals and letters shall illuminate white. A position indicator of the digital-readout or dot-matrix type (minimum 50 mm (2 inch) high indication) shall be provided in car transom panel. Number corresponding to car position shall remain illuminated when motor drive is shut down. Illumination shall be shrouded in an approved manner to protect against glare from car lighting.

2.6.7 Audible Signals

An audible signal shall be provided at each floor landing and in each car and shall sound coincident with the lantern illumination indicators. The audible signal shall be no less than 20 decibels with a frequency no higher than 1500 Hz. The audible signal shall sound once for UP direction and twice for DOWN direction.

2.6.8 Combination Hall-Position Indicator and Directional Arrows

A digital-readout position and direction indicator (minimum 50 mm (2 inch) high indication) for passenger elevators shall be provided over entrance. As elevator travels in hoistway, elevator position shall be indicated by illumination in alpha-numeric characters corresponding to the landing where elevator is stopped or passing. Number corresponding to position of car shall remain illuminated when motor is shut down. An audible signal shall sound in elevator car to indicate that the elevator is stopping or passing a floor served by elevator. Fixture design and operation shall be similar in design to that specified for Car Position Indicator.

2.7 PASSENGER CAR OPERATION (SINGLE-CAR SELECTIVE/COLLECTIVE)

Passenger Elevator: Car shall be arranged so that by pressing one or more car buttons or landing buttons the car will start automatically and stop at first floor for which the button has been pressed which corresponds to the direction in which the car is traveling. Car shall stop in the order in which the floors are reached by the car and at all floors for which calls have been registered, regardless of the sequence in which buttons have been pressed, provided button for a given floor has been pressed sufficiently in advance of car's arrival at that floor to permit the stop to be made. If car buttons have not been pressed, and car responds to several DOWN calls, car shall travel to highest DOWN call first and then reverse to collect UP calls. UP calls shall be collected in the same way when car starts DOWN in response to UP calls by first stopping for the lowest UP call registered. When a car has stopped in response to the pressing of a landing button and a car button is pressed corresponding to the direction in which the car has been traveling, within a predetermined interval of time after the stop, the

car shall continue in that direction regardless of other landing calls registered. While car is in motion landing calls in the opposite direction of car movement shall not affect the operation of car but calls shall remain registered. After last car call has been answered in the direction the car is traveling, car shall automatically reverse and answer registered landing calls and all car calls in the order the landings are reached. When all calls have been answered, the car shall stop at the last floor served and shall have the doors closed.

2.8 AUTOMATIC EMERGENCY POWER OPERATION

Elevator control system shall be arranged to operate on emergency power supply upon failure of the normal power supply. Elevators operating on dedicated service, such as fire service, will not be required to return to designated landing when emergency power becomes available for respective elevator. Elevators shall operate as follows:

a. When normal power supply fails, car shall shut down.

b. Car shall automatically start and travel at full-rated speed to designated landing, stop, open the car and hoistway doors, then shut down.

2.9 AUTOMATIC ELEVATOR OPERATION

2.9.1 General

The operating device shall consist of a series of push-buttons in the car numbered to correspond to various landings, "UP" and "DOWN" buttons at intermediate landings and a single button at terminal landing. To meet the elevator operation requirements specified in this section all buttons shall be connected electrically to the control system which governs the floor selection, car selection, direction of travel and governs the acceleration and retardation.

2.9.2 Operation

Car calls shall be registered within the car by pressing the button corresponding to the designated floors. Hall calls shall be registered by pressing buttons in the corridor push-button fixture. Once the demand for elevator service has been established and the car has received a start signal the car operation shall be as follows.

2.9.2.1 Door Closing

Doors shall close automatically. When doors are fully closed and the interlock circuit established, the car shall start to move in the direction established by control system. Car shall accelerate and decelerate automatically and stop at first floor for which a car button has been registered or at first floor for a corridor demand which has been assigned to car. Car shall stop at all floors for which car calls are registered in the order in which the floors are reached and shall stop for any corridor demands assigned to the cars in the order in which the floors are reached.

2.9.2.2 Door Opening

Doors shall open automatically as car reaches the landing. After a predetermined time the doors shall close and the car shall proceed to answer the remaining car or assigned corridor calls. A protective device such as a safety edge and light beam device shall be provided on car door and when activated will prevent closing of doors. Cars shall become available for assignment at whatever floor the last car demand has been satisfied in the direction in which the car is traveling.

2.9.2.3 Car Dispatch

When car does not receive a demand dispatch at dispatching floor for an adjustable time period up to 10 minutes set initially at 5 minutes, the motor drive unit shall be switched-off. If the car's switched-off motor drive unit receives a demand dispatch the motor drive unit shall automatically restart.

2.9.2.4 Door Dwell-Time

Door open dwell-times shall be adjustable so that the open time for a car call is shorter than the open time for corridor calls and second passengers. If a longer time is needed for passenger entry, doors can be prevented from closing or reversing by the light beam door control, the protective leading edge on car door, or by pressing "DOOR OPEN" button in car. Door dwell-times shall comply with FED-STD 795 and 36 CFR 1191.

2.9.3 Independent Service

Freight elevators shall be arranged for independent service operation with a key-switch located in the locked section of car operating panel. When the car key-switch is placed in the "ON" position the key-switch shall remove car from corridor button operation to permit operation from car buttons only. Elevator direction lanterns shall be inoperative when elevator is in this mode of operation.

2.9.4 Automatic Load Weighing

Passenger elevators shall be provided with load-weighing devices which will cause elevator to bypass hall calls when elevator is filled to an adjustable percentage. Corridor calls shall remain registered until the next available car responds to the call.

2.9.5 Anti-Nuisance

Passenger elevators shall be provided with a system which will cancel all car calls in the event that between 3 to 5 times the number of car calls are registered as there are passengers in car, allowing 70 kg per passenger.

2.9.6 Door Operation

Double-door operation are not acceptable for passenger elevators. If an UP traveling car has a passenger for an intermediate floor and a DOWN call is registered at that floor with no-calls above car, the car shall travel to floor, open the door and let passenger out, then light the DOWN direction arrow in hall lantern and accept the waiting passenger who registered the DOWN call. Doors shall not perform the open-close cycle before elevator proceeds to next call.

2.9.7 Automatic Power Shutdown

Automatic power shutdown of the elevators will be initiated by a waterflow switch supervising sprinklers located in the elevator machine room or in the elevator hoistway. Provide heat detectors which are fixed-temperature-rate-of-rise type, rated at 57 to 60 degrees C adjacent to each sprinkler head in the hoistway(s) and in the machine room. Heat detectors shall be connected to the elevator control system which shall cause the following to the affected elevators), upon activation of the heat detector.

a. Elevators which are in motion will proceed to the nearest available landing away from fire floor, and shall cause power-operated doors to open and remain openuntil manually reset.. The fire floor is considered the floor where the actuated heat detector is located.

b. Elevators which are standing at a landing with open doors will remain open at the floor. If power-operated doors are closed, the elevator system will cause doors to open.

2.10 SENSOR AND CONTROL WIRE SURGE PROTECTION

Digital and analog inputs shall be protected against surges induced on control and sensor wiring. Digital and analog outputs shall be protected as shown against surges induced on control and sensor wiring installed outdoors. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:

a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An eight microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

2.11 COMMUNICATIONS LINKS SURGE PROTECTION

Communications equipment shall be protected against surges induced on any communications link. Cables and conductors, except fiber optics, which serve as communications links from Motor Control Room (MCR) to field equipment, and between field equipments shall have surge protection circuits installed at each end. Protection shall be furnished at equipment and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 1 m of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An eight microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

2.12 COMMUNICATIONS LINKS OVER VOLTAGE PROTECTION

Communications equipment such as MODEMs, line drivers, and repeaters shall be protected against overvoltage on any communications link conductors. Cables and conductors, which serve as communications links, except fiber optics, shall have overvoltage protection for voltages up to 480 Vac rms, 60 Hz installed. Instrument fuses or fusible resistors are required for this application.

2.13 FIREFIGHTERS SERVICE

Firefighter service shall be in accordance with ASME A17.1 for automatic elevators. Elevator lobby and machine room smoke detectors shall be in accordance with Section 13851 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE .

2.14 ELEVATOR POWER UNIT

2.14.1 Pumping and Control Mechanism

Hydraulic fluid shall be biodegradable type and provided in the reservoir, pump and control valve. Hydraulic fluid shall have a minimum fire point of 190 degrees C (375 degrees F) as established by ASTM D 92. If oil temperature drops below pre-set minimum, elevator shall be dispatched automatically to lowest terminal floor at which point the pump will bypass oil in system without car motion until pre-set temperature is reached. Normal response to passenger demand shall not be affected by this control. Resistance type heating elements do not meet the intent of this specification.

2.14.1.1 Oil Temperature Device

An oil temperature device shall be provided that will maintain oil temperature between 21 degrees C (70 degrees F) and 38 degrees C (100 degrees F) regardless of ambient temperatures.

2.14.1.2 Pump

Pump shall be a rotary-positive displacement type for oil-hydraulic elevator service designed for steady discharge with minimum pulsation to give smooth and quiet operation, with an output which will not vary more than 10 percent between no-load and full-load on the elevator. Operating pressure shall not exceed 2760 kPa (400 psi).

2.14.1.3 Piping

Piping shall be ASTM A 53 Grade E or S, ASTM A 106 Grade B, or grooved piping system of minimum schedule 40 seamless steel conforming to ASME A17.1 and ASME B16.11. Pipes shall conform to the cleanliness requirements of ASME B31.1.

2.14.1.4 Motor

Motor shall be rated 50 horseposer;especially designed for oil-hydraulic elevator service; shall be of standard manufacture duty rating; and provided with specified speeds and loads.

2.14.1.5 Oil-Control Unit

Oil-control unit shall contain the following valve assemblies:

a. Automatic shut-off valve shall be provided in the oil-supply line as close to the cylinder inlet as possible. When there is a 10 percent drop in NO-LOAD operating pressure, the automatic shut-off valve shall be activated. When activated, the device shall immediately stop the descent of elevator and hold the elevator until it is lowered by use of the maximum lowering feature of the valve. Manual lowering feature of automatic shut-off valve shall be arranged to limit the maximum descending speed of elevator to 0.08 m/s (15 feet per minute). Exposed adjustments of automatic shut-off shall have the means of adjustment sealed after being set to the correct position.

b. Relief-valve for hydraulic shall be externally adjustable and shall bypass the total oil flow without increasing back pressure by more than 56 percent above working pressure.

c. Safety check-valve shall close quietly without permitting any perceptible reverse flow and shall be designed to support the elevator on a positively locked column of oil when car is at rest.

d. Up-start and stop valve shall be externally adjustable and shall bypass oil flow during the start-and-stop of motor-pump assembly. Valve shall close slowly, gradually diverting oil to the jack unit to insure smooth up-start and up-step.

e. Lowering and leveling valve shall be externally adjustable for drop-away speed, lowering speed, leveling speed and stopping speed to insure smooth down-starts and stops. Leveling valve shall be designed to level the car to floor in the direction the car is traveling when slowdown is initiated.

f. Manual lowering valve shall be capable of lowering the elevator car in event of power failure. Manual-lowering valve shall be arranged to limit the maximum descending speed under manual operation to 0.08 m/s (15 fpm).

g. A service check-valve shall be installed in oil supply line between power unit and jack.

2.14.1.6 Storage Tank

Storage tank shall be single-wall construction of steel with a steel cover. Manufacturer's recommendation for the type of oil to be used shall be included in written instructions for the care, adjustment and maintenance of equipment.

2.14.1.7 Controller

Electric controller shall be of the microprocessor based logic type with battery backup provided with reduced voltage starting. Components required for proper elevator performance shall be neatly mounted and wired and completely enclosed in a cabinet with a mechanically-latched door. Control cabinet shall be designed for mounting on power unit, wall or floor stand. Electric control apparatus shall be completely isolated from oil reservoir. A feature shall be incorporated in electrical control circuit which will cause elevator car to descent automatically to the lowest terminal landing, if the system runs low on oil during ascending of the car. If

power-operated doors are used, the car and hoistway doors shall automatically open when car reaches landing to allow passengers to exit. Parked car shall have doors in closed position and all control buttons shall be made inoperative.

2.14.2 Sound Reduction

Sound-insulating panels shall isolate airborne noise from motor pump assembly. Openings shall be provided to adequately ventilate the power unit motor. A minimum of two sound-isolating couplings shall be installed in oil line in machine room between pump and jack. Couplings shall be designed and manufactured to be blowout proof. Oil-hydraulic silencer shall be installed in oil line near power unit and shall contain pulsation absorbing material surrounded by a blowout-proof housing. Power unit assembly shall be mounted on vibration pads to isolate the unit from building structure.

2.15 LEVELING DEVICE

Elevators shall be equipped with a 2-way leveling device to automatically bring the car to floor landings. Car shall automatically re-level at each landing to correct the overtravel and undertravel, and maintain the level regardless of load on car. Electric stopping system shall be arranged so that the car will stop level with the floor before brake is set. Stopping accuracy shall not exceed a plus or minus 6 mm.

2.16 JACK UNIT

Jack unit shall be designed and constructed of sufficient size to lift the gross load to the height specified and shall be free from oil leakage. Brittle material such as grey cast iron shall not be used in jack construction. Jack unit shall consist of the following:

a. Direct displacement plunger fabricated of heavy seamless steel tubing accurately turned and polished.

b. Stop-ring welded or screwed to the plunger to positively prevent plunger from leaving the cylinder.

c. Internal guide bearing.

d. Packing or seal.

e. Drip ring around cylinder top.

f. Outer cylinder made of steel tubing.

g. Air bleeder.

h. Brackets welded to jack cylinder for supporting the elevator on pit channels.

i. Scavenger pump with copper tubing connected to the tank.

2.17 ELEVATOR SUPPORTS

Structural steel beams, inserts, brackets, bolts and fastening devices shall be provided for proper installation of elevator equipment. Wood plugs are not acceptable.

2.18 BUFFERS

Buffers shall be of design suitable for depth of pit. Buffer anchorage at pit floors shall be provided for each car and counterweight and arranged to avoid puncturing the pit waterproofing. Type of buffer used shall be tested and approved for compliance with elevator service requirements before installation. Pipe struts and steadiers shall be provided as required for pit conditions. A metal plate with information concerning stroke and load-rating shall be permanently fastened to each buffer. Pit-mounted buffers shall have an adequate stroke designed to bring the fully-loaded car and counterweight to rest from governor tripping speed at an average rate of retardation not exceeding gravity. Moving portion of buffer shall be designed to be accelerated by the car without noticeable peak retardation. Spring buffers shall be in accordance with ASME A17.1 A17.1.

2.19 LUBRICATION POINTS

Every part subject to movement friction shall be provided with provisions for oil or grease lubrication. All points of lubrication shall be readily accessible.

PART 3 EXECUTION

3.1 INSTALLATION

Elevators and equipment shall be installed in accordance with ASME A17.1 and manufacturer's recommendation. Guide rails shall be set plumb and parallel and attached to guide rail brackets secured to building structure as indicated and at intervals not exceeding 200 mm Steel shim plates shall be used for aligning equipment. Guide rail sections shall be joined together in accordance with ASME A17.1. Guide rails shall be thoroughly cleaned and made smooth before elevator is put into operation. During installation all stainless steel shall be protected.

3.2 FIELD WELDING

When structural or load-bearing members are to be field welded, welding and qualification of welders shall be as specified in Section 05055WELDING, STRUCTURAL.

3.3 CASING, CYLINDER AND PLUNGER UNIT

A steel casing minimum 200 mm larger in diameter than the cylinder sealed at bottom with steel plate or concrete plug shall be complete with provisions to accommodate a double wall cylinder. Casing shall be accurately positioned, plumbed and set to accept the cylinder. The cylinder shall be protected from corrosion by totally enclosing the cylinder with a separate schedule 80, polyvinyl chloride jacket or with a high density, fused polyethylene coating, recommended by the manufacturer. Area between casing and cylinder wall shall be filled with washed dry sand after cylinder has been accurately located. Top of casing shall be sealed. The work of boring the well and setting the cylinder shall be coordinated with construction of concrete pit.

3.4 ELEVATOR WIRING

Wiring shall be provided for electrically-operated items of elevator

equipment to comply with requirements of NFPA 70 and Section 16415 ELECTRICAL WORK, INTERIOR. For control and signal circuits wire shall be minimum No. 16 AWG. For power and lighting circuits wire shall be minimum No. 12 AWG. Work light fixtures equipped with 150 watt incandescent lamps and ground duplex receptacles shall be provided at top and bottom of car. Work light fixtures and traveling cable junction boxes shall be located to provide illumination at junction boxes. Wiring shall terminate in junction boxes. Wires shall be identified and shall match symbols shown on wiring diagrams. Control and signal wires shall be brought to accessible numbered terminal blocks on the controller. Intra-panel wiring shall be flame-resistant type.

3.4.1 Traveling Cables

Cables shall terminate at numbered terminal blocks in car and machine room. Traveling cable shall be provided with a separate shielded circuit for communication system and hang to obtain proper size of loop. Traveling cable shall be provided with 10 percent spare conductors for each car.

3.5 PAINTING AND PIPE COLOR CODE MARKING

Except for factory-finished items and corrosion-resistant items, machined surfaces shall be painted as specified in Section 09900 PAINTING, GENERAL.Color Code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

3.6 TESTING

Testing shall be in accordance with requirements of ASME A17.1and ASME A17.2.2; and as specified below. The Contractor shall conduct a complete test of the system. After the system has passed all tests, the Contractor shall notify the Contracting Officer in writing, 14 days prior to the time of performing the acceptance test, that the system is complete and is ready for final acceptance testing. The Contractor after receiving written approval from the Contracting Officer will conduct a complete acceptance test of the system. The Contractor shall provide the services of an elevator inspector, employed by an independent testing company to inspect the elevators, witness the final testing and certify the elevators. The inspector shall meet all qualification requirements of ASME QEI-1 and shall be certified in accordance with ASME QEI-1. The Contractor shall provide an elevator certificate signed by the inspector for each elevator. The certificate shall be provided to the Contracting Officer within 30 day after the completion of all testing.

3.6.1 Testing Period

Each elevator shall be tested with the specified rated-load in car continuously for a period of 35 percent of the duty time. During the test run the car shall be stopped at all floors in both directions of travel for a standing period of 10 seconds per floor. A manual test of the final limits (UP and DOWN overtravel) shall also be performed.

3.6.2 Speed Load Testing

The actual speed of elevator car in both directions of travel shall be determined with the rated-load and with no-load in the elevator car. Actual measured speed of car with the rated-load in the UP direction shall be within 5 percent of rated speed. The maximum difference in actual measured speeds obtained under the various conditions outlined shall not

exceed 10 percent of the total difference between the UP and DOWN speeds.

3.6.3 Car Leveling Testing

Elevator car-leveling devices shall be tested for accuracy of landing at all floors with no-load in car, with symmetrical load in car and with the rated-load in car in both directions of travel.

3.6.4 Temperature Rise Testing

Temperature rise of hydraulic pump motor, motor drive, exciter and booster shall be conducted during the full-load test run for minimum one hour. Under these conditions, temperature rise of equipment shall not exceed the requirements established in NEMA MG 1 Chapter 12. Test shall be started when all parts of equipment are within the temperature required by NEMA at time of starting tests.

3.6.5 Insulation-Resistance Testing

Insulation-resistance testing shall be performed to ensure that the complete elevator wiring systems will be free from short circuits and grounds. Electrical conductors shall have an insulation-resistance of not less than 1 megohm between each conductor and ground, and not less than 1 megohm between each conductor and all other conductors. Prior to testing, provisions shall be made to prevent damage to electronic devices.

3.7 FRAMED INSTRUCTIONS

Two sets of instructions shall be typed and framed under glass or in laminated plastic, and posted side-by-side in the elevator room where directed before acceptance of elevator systems. First set of instructions shall include wiring and control diagrams showing the complete layout of elevator system. Second set of instructions shall include the condensed operating instructions describing preventive maintenance procedures, the methods for checking the elevator system for normal safe operation, and the procedures for safely starting and stopping the elevator system.

3.8 OPERATOR TRAINING

Contractor shall conduct a formal training course for operating Government personnel which shall include care, lubrication, adjustment and maintenance of elevator equipment. Training period shall consist of a total of 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. Field instructions shall cover all of the items contained in the operating and maintenance instructions, including demonstrations of routine maintenance operations. Contracting Officer shall be notified at least 14 days prior to date of starting the training course.

-- End of Section --

SECTION 16263

DIESEL-GENERATOR SET STATIONARY 100-2500 KW, WITH AUXILIARIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1995) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 181/A 181M	(1995b) Carbon Steel Forgings for General-Purpose Piping
ASTM A 234/A 234M	(1996b) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM D 975	(1996a) Diesel Fuel Oils

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B31.1	(1995; B31.1a; B31.1b) Power Piping
ASME BPV IX	(1995; Addenda Dec 1995, Dec 1996) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE Std 43	(1974; R 1991) Testing Insulation

	Resistance of Rotating Machinery
IEEE Std 95	(1977; R 1991) Insulation Testing of Large AC Rotating Machinery with High Direct Voltage
IEEE Std 112	(1991) Standard Test Procedure for Polyphase Induction Motor and Generators
IEEE Std 115	(1995) Test Procedures for Synchronous Machines

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves

MILITARY STANDARDS (MIL-STD)

MIL-STD 705	(Rev C) Generator Sets, Engine Driven Methods of Tests and Instructions

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA MG 1	(1993; Rev 1; Rev 2; Rev 3) Motors and Generators
NEMA PB 1	(1990) Panelboards
NEMA PB 2	(1995) Deadfront Distribution Switchboards
NEMA SG 5	(1990) Power Switchgear Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1996; Errata) Flammable and Combustible Liquids Code
NFPA 37	(1997) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	([AM#0001]1999; Errata) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE ARP 892	(1994; R 1994) D-C Starter-Generator, Engine
SAE J 537	(1994) Storage Batteries

UNDERWRITERS LABORATORIES (UL)

UL 1236	(1994; Rev thru Apr 1996) Battery Chargers for Charging Engine-Starter Batteries

1.2 SYSTEM DESCRIPTION

Each engine-generator set shall be provided and installed complete and totally functional, with all necessary ancillary equipment to include: air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine-generator set shall satisfy the requirements specified in the Engine-Generator Parameter Schedule.

1.2.1 Engine-Generator Parameter Schedule

ENGINE-GENERATOR PARAMETER SCHEDULE

Power Rating	Standby
Overload Capacity (Prime applications only)	100 percent of Service Load for 1 hour in 12 consecutive hours
Service Load	per plans
Power Factor	0.8 lagging
Engine-Generator Applications	stand-alone
Maximum Speed	1800 rpm
Heat Exchanger Type	fin-tube (radiator)
Governor Type	Isochronous
Frequency Bandwidth (steady state)	plus/minus 0.4 percent
Governor Type	Droop
Frequency Regulation (droop) (No Load to Full Load)	4 percent (maximum)
Frequency Bandwidth (steady state)	plus/minus 0.4 percent
Voltage Regulation (No Load to Full Load)	plus/minus 5 percent (maximum)
Voltage Bandwidth (steady state)	plus/minus 0.5 percent

ENGINE-GENERATOR PARAMETER SCHEDULE

Frequency	60 Hz
Voltage	480/277 volts
Phases	3 Phase, Wye
Minimum Generator Subtransient Reactance	16.5 percent
Nonlinear Loads	80 kVA
Max Step Load Increase	100 percent of Service Load at .8 PF
Transient Recovery Time with Step Load Increase (Voltage)	10 seconds
Transient Recovery Time with Step Load Increase (Frequency)	10 seconds
Maximum Voltage Deviation with with Step Load Increase	25 percent of rated voltage
Maximum Frequency Deviation with Step Load Increase	5 percent of rated frequency
Max Step Load Decrease (without shutdown)	100 percent of Service Load at .8 PF
Max Time to Start and be Ready to Assume Load	10 seconds
Max Summer Outdoor Temp (Ambient)	43.3 degrees C
Min Winter Outdoor Temp (Ambient)	4.44 degrees C
Seismic Zone	1
Installation Elevation	at sea level

1.2.2 Rated Output Capacity

The generator shall be sized to 350 rated standby KW.

1.2.3 Power Ratings

Each standby power engine-generator set application shall be capable of 500 cumulative hours of operation per year with a maximum period of continuous operation of 300 hours at output capacity.

1.2.4 Transient Response

The engine-generator set governor and voltage regulator shall cause the engine-generator set to respond to the maximum step load changes such that

output voltage and frequency recover to and stabilize within the operational bandwidth within the transient recovery time. The engine-generator set shall respond to maximum step load changes such that the maximum voltage and frequency deviations from bandwidth are not exceeded.

1.2.5 Reliability and Durability

Each standby engine-generator set shall have both an engine and a generator capable of delivering the specified power on a standby basis with an anticipated mean time between overhauls of no less than 5,000 hours up to 400 kW operating with an 80 percent load factor. Two like engines and two like generators shall be cited that have performed satisfactorily in a stationary power plant, independent and separate from the physical location of the manufacturer's and assembler's facilities, for standby without any failure to start, including all periodic exercise. Each like engine and generator shall have had no failures resulting in downtime for repairs in excess of 72 hours nor any failure due to overheating during the 2 consecutive years of service. Like engines shall be of the same model, speed, bore, stroke, number and configuration of cylinders, and rated output capacity. Like generators shall be of the same model, speed, pitch, cooling, exciter, voltage regulator and rated output capacity.

1.3 GENERAL REQUIREMENTS

1.3.1 Engine-Generator Set

Each set shall consist of one engine, one generator, and one exciter mounted, assembled, and aligned on one base; and other necessary ancillary equipment which may be mounted separately. Sets having a capacity of 750 kW or smaller shall be assembled and attached to the base prior to shipping. Sets over 750 kW capacity may be shipped in sections. Each set component shall be environmentally suitable for the location shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. Any nonstandard products or components and the reason for their use shall be specifically identified in paragraph SUBMITTALS.

1.3.2 Nameplates

Each major component of this specification shall have the manufacturer's name, type or style, model or serial number and rating on a plate secured to the equipment. As a minimum, nameplates shall be provided for:

Engines	Relays
Generators	Transformers (CT & PT)
Regulators	
Pumps and pump motors	Governors
Generator Breaker	Air Starting System
Economizers	Heat exchangers (other than base mounted)

Where the following equipment is not provided as a standard component by the diesel engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

Battery charger	Heaters
Switchboards	Exhaust mufflers

Switchgear	Silencers
Battery	Exciters

1.3.3 Personnel Safety Devices

Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. The safety devices shall be installed so that proper operation of the equipment is not impaired.

1.3.4 Verification of Dimensions

Before performing any work, the premises shall be visited and all details of the work verified. The Contracting Officer shall be advised in writing of any discrepancies.

1.3.5 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or standard such as UL, NEMA, etc., the design, fabrication and installation shall also conform to the code.

1.3.6 Site Welding

Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL. For all other welding, procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified employer may be accepted as permitted by ASME B31.1. Welder qualification tests shall be performed for each welder whose qualifications are not in compliance with the referenced standards. The Contracting Officer shall be notified 24 hours in advance of qualification tests. The qualification tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record.

1.3.7 Engine-Generator Set Enclosure

The engine-generator set enclosure shall be corrosion resistant and fully weather resistant. The enclosure shall contain all set components and provide ventilation to permit operation at Service Load under secured conditions. Doors shall be provided for access to controls and equipment requiring periodic maintenance or adjustment. Removable panels shall be provided for access to components requiring periodic replacement. The enclosure shall be capable of being removed without disassembly of the engine-generator set or removal of components other than the exhaust system.

1.3.8 Vibration Limitation

The maximum engine-generator set vibration in the horizontal, vertical, and axial directions shall be limited to 0.15 mm (peak-peak RMS), with an overall velocity limit of 24 mm/second RMS.

1.3.9 Harmonic Requirements

Non-linear loads to be served by each engine-generator set are as indicated. The maximum linear load demand (kVA @ PF) when non-linear loads will also be in use is as indicated.

1.3.10 Starting Time Requirements

Upon receipt of a signal to start, each engine generator set will start, reach rated frequency and voltage and be ready to assume load within the time specified. For standby sets used in emergency power applications, each engine generator set will start, reach rated frequency and voltage, and power will be supplied to the load terminals of the automatic transfer switch within the starting time specified.

1.3.11 Experience

Each component manufacturer shall have a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use. The engine-generator set manufacturer/assembler shall have a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment and Performance; GA.

Calculations of the engine and generator output power capability, including efficiency and parasitic load data.

Harmonic and Non-linear Load Capability; GA.

Description of the generator features which mitigate the effects of the non-linear loads listed.

Torsional Vibration; FIO.

Calculations which show that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator.

Power Factor Capability Curve; FIO.

The generator capability curve showing generator kVA output capability (kW vs. kvar) for both leading and lagging power factors ranging from 0 to 1.0.

Cooling Equipment and Performance; FIO.

A letter which certifies that the engine-generator set and cooling system function properly in the ambient temperature specified.

a. The maximum allowable inlet temperature of the coolant fluid.

b. The minimum allowable inlet temperature of the coolant fluid.

c. The maximum allowable temperature rise in the coolant fluid through the engine.

Alarm Set Points; GA.

The magnitude of monitored values which define alarm or action set points, and the tolerance (plus and/or minus) at which the devices activate the alarm or action for items contained within the alarm panels.

Generator Data; GA.

Manufacturer's standard data for each generator (prototype data at the specified rating or above is acceptable), listing the following information:

Temperature rise in accordance with NEMA MG 1, Part 22.

Direct-Axis synchronous reactance (per unit).

Direct-Axis transient reactance (per unit).

Direct-Axis subtransient reactance (per unit).

Quadrature synchronous reactance (per unit).

Quadrature subtransient reactance (per unit).

Zero sequence reactance (per unit).

Negative sequence reactance and impedance (per unit).

Direct-Axis transient open-circuit time constant (seconds).

Direct-Axis short circuit time constant (seconds).

The generator kW rating and short circuit current capacity (both symmetric and asymmetric)

Manufacturer's Catalog; GA.

Manufacturer's standard catalog data describing and depicting each engine-generator set and all ancillary equipment in sufficient detail to demonstrate complete specification compliance.

Site Welding; FIO.

A copy of qualifying procedures and a list of names and identification symbols of qualified welders and welding operators.

Spare Parts; GA.

A complete list of spare parts for each piece of equipment and a complete list of all material and supplies needed for continued operation. Lists shall include supply source and current prices. Each list shall be separated into two parts, those elements recommended by the manufacturer to be replaced after 3 years of service, and the remaining elements.

Training; GA.

A letter giving the date proposed for conducting the onsite training course, the agenda of instruction, a description of the video taping service to be provided, and the kind and quality of the tape to be left

with the Contracting Officer at the end of the instructional period.

Battery Charger; GA.

Battery charger sizing calculations.

SD-04 Drawings

Layout and Shop Drawings; GA.

Drawings shall include the following:

a. Base-mounted equipment, complete with base and attachments, including anchor bolt template and recommended clearances for maintenance and operation.

b. Complete starting system.

c. Complete fuel system.

d. Complete cooling system.

e. Complete exhaust system.

f. Layout of relays, breakers, switchgear, and switches including applicable single line and wiring diagrams with written description of sequence of operation and the instrumentation provided.

g. The complete lubrication system, including piping, pumps, strainers, filters, controls and wiring.

h. Location, type, and description of vibration isolation devices for all applications.

i. The safety system, together with a detailed description of how it is to work. Wiring schematics, safety devices with a listing of their normal ranges, alarm and shutdown values (to include operation parameters such as pressures, temperatures voltages, currents, and speeds) shall be included.

j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and instrumentation.

k. Layout of each panel.

l. Mounting and support for each panel and major piece of electrical equipment.

m. Engine-generator set lifting points and rigging instructions.

As-Built Drawings; GA.

Drawings which accurately depict the as-built configuration of the installation, upon acceptance of the diesel-generator set installation.

SD-06 Instructions

Posted Data; GA.

Posted data including wiring and control diagrams showing the key mechanical and electrical control elements, and a complete layout of the entire system.

Framed Instructions; GA.

Instructions including: the manufacturers pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions.

SD-08 Statements

Qualifications; FIO.

Documentation to demonstrate that:

a. Each component manufacturer has a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use.

b. The engine-generator set manufacturer/assembler has a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

c. The field engineer is qualified to perform the specified functions.

d. Certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.

Welder Qualification; FIO.

A letter listing the welder qualifying procedures for each welder, complete with supporting data such as test procedures used, what was tested to, and a list of the names of all welders and their identification symbols.

Installation Procedures; FIO.

A copy of the manufacturer's installation procedures and a detailed description of the manufacturer's recommended break-in procedure.

Listing of Product Installations; FIO.

A list of five installations using each type of engine and generator proposed for use. Each component used as the basis for the durability and reliability certification shall be identified in the list. The list shall give the name of installations, completion dates, and name and telephone number of a point of contact.

SD-09 Reports

Factory Inspection and Tests; FIO.

Six complete reproducible copies of the factory inspection result on the checklist format specified in paragraph FACTORY INSPECTION AND TESTS.

Factory Tests; FIO.

a. A letter giving notice of the proposed dates of factory inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the manufacturer's procedures for factory tests.

Six copies of the Factory Test data described below in 215.9 x 279.4 mm binders having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs. Data plots shall be full size (215.9 x 279.4 mm minimum), showing grid lines, with full resolution.

(1) A detailed description of the procedures for factory tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) A list of the parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of adjustments made.

On Site Tests; GA.

a. A letter giving notice of the proposed dates of onsite inspections and tests.

b. A detailed description of the Contractor's procedures for onsite tests including the test plan and a listing of equipment necessary to perform the tests.

c. Six copies of the onsite test data described below in 215.9 x 279.4 mm binders having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs. Data plots shall be full size (215.9 x 279.4 mm minimum), showing grid lines, with full resolution.

(1) A detailed description of the procedures for onsite tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) A list of the parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of adjustments made.

SD-13 Certificates

Torsional Vibration; GA.

Torsional analysis and calculations which certify and demonstrate that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator, at synchronous speeds, plus/minus 10%.

Prototype Tests; FIO.

Manufacturer's standard certification that prototype tests were performed for the generator model proposed.

Reliability and Durability; GA.

A reliability and durability certification letter from the manufacturer and assembler to prove that existing facilities are and have been successfully utilizing the same components proposed to meet this specification, in similar service. Certification may be based on components, i.e. engines used with different models of generators and generators used with different engines, and does not exclude annual technological improvements made by a manufacturer in his basic standard-model component on which experience was obtained, provided parts interchangeability has not been substantially affected and his current standard model meets the performance requirements specified.

Emissions; GA.

A certification from the engine manufacturer stating that the engine emissions meet the federal, state, and local regulations and restrictions specified.

Site Visit; GA.

A letter stating the date the site was visited and listing discrepancies found.

Flywheel Balance; FIO.

A certification stating that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125 percent of rated speed without vibration or damage.

Standards Compliance; GA.

A certification stating that where materials or equipment are specified to comply with requirements of UL, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.

Functional Facilities; GA.

A letter certifying that all facilities are complete and functional; that each system is fully functional; and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use.

SD-19 Operation and Maintenance Manuals

Operation Manual; GA.

Six copies of the operation manual in 215.9 x 279.4 mm binders, having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each system or subsystem. Sections shall be separated by heavy plastic dividers with tabs which identify the material in the section. Drawings shall be folded blue lines, with the title block visible, and placed in 215.9 x 279.4 mm plastic pockets with reinforced holes. One full size reproducible mylar of each drawing shall accompany the booklets. Mylars shall be rolled and placed in a heavy cardboard tube with threaded caps on each end. The manual shall include: step-by-step procedures for system startup, operation, and shutdown; drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems together with their controls, alarms, and safety systems; the manufacturer's name, model number, and a description of equipment in the system. The instructions shall include procedures for interface and interaction with related systems to include automatic transfer switches, fire alarm/suppression systems, load shedding systems. Each booklet shall include a compact disc (CD) containing a Microsoft Word 97 or equal file of procedures. The operation manual shall be submitted and approved prior to commencing onsite tests.

Maintenance Manual; GA.

Six copies of the maintenance manual containing the information described below in 215.9 x 279.4 mm binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each item listed. Each section shall be separated by a heavy plastic divider with tabs. Drawings shall be folded, with the title block visible, and placed in plastic pockets with reinforced holes. One copy of the manual shall be provided as an electronic document on compact disc. The document shall be readable by either Microsoft Word 97 or Adobe Acrobat.

a. Procedures for each routine maintenance item.

b. Procedures for troubleshooting.

c. Factory-service, take-down overhaul, and repair service manuals, with parts lists.

d. A copy of the posted instructions.

e. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components specified for nameplates.

Six complete reproducible copies of the final relay and protective device settings. The settings shall be recorded with the name of the company and individual responsible for their accuracy.

Special Tools and Filters; FIO.

Two complete sets of special tools required for maintenance (except for

electronic governor handset). Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. The tools shall be supplied complete with a suitable tool box. One handset shall be provided for each electronic governor when required to indicate and/or change governor response settings. Two complete sets of filters shall be supplied in a suitable storage box.

1.5 STORAGE AND INSTALLATION

The Contractor shall properly protect material and equipment, before, during, and after installation. Stored items shall be protected from the weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Filter Elements

Fuel-oil, lubricating-oil, and combustion-air filter elements shall be manufacturer's standard.

2.1.2 Instrument Transformers

ANSI C12.11.

2.1.3 Pipe (Sleeves, Fuel/Lube-Oil, Compressed Air, Coolant, and Exhaust)

ASTM A 53, or ASTM A 106 steel pipe. Pipe smaller than 50 mm (2 inches) shall be Schedule 80. Pipe 50 mm (2 inches) and larger shall be Schedule 40.

a. Flanges and Flanged Fittings: ASTM A 181/A 181M, Class 60, or ASME B16.5, Grade 1, Class 150.

b. Pipe Welding Fittings: ASTM A 234/A 234M, Grade WPB or WPC, Class 150 or ASME B16.11, 1360.7 kg.

c. Threaded Fittings: ASME B16.3, Class 150.

d. Valves: MSS SP-80, Class 150.

e. Gaskets: Manufacturer's standard.

2.1.4 Thermometer for Oil or Water Service

Flush-mounted dial with range to suit the service encountered, standard with the manufacturer.

2.1.5 Pipe Hangers

MSS SP-58 and MSS SP-69.

2.1.6 Electrical Enclosures

2.1.6.1 General

NEMA ICS 6.

2.1.6.2 Power Switchgear Assemblies

NEMA SG 5.

2.1.6.3 Switchboards

NEMA PB 2.

2.1.6.4 Panelboards

NEMA PB 1.

2.1.7 Pressure Gauges

Manufacturer's standard.

2.1.8 Electric Motors

Electric motors shall conform to the requirements of NEMA MG 1. Motors shall have sealed ball bearings and a maximum speed of 1800 rpm. Motors used indoors shall have drip-proof frames; those used outside shall be totally enclosed. Alternating current motors larger than 373 W shall be of the squirrel-cage induction type for operation on 208 volts or higher, 60 Hz, and three-phase power. Alternating current motors 373 W or smaller, shall be suitable for operation on 120 volts, 60 Hz, and single-phase power. Direct current motors shall be suitable for operation on 125 volts.

2.1.9 Motor Controllers

Motor controllers and starters shall conform to the requirements of NFPA 70 and NEMA ICS 2.

2.2 ENGINE

Each engine shall operate on No. 2-D diesel fuel conforming to ASTM D 975, shall be designed for stationary applications and shall be complete with ancillaries. The engine shall be a standard production model described in the manufacturer's catalog. The engine shall be naturally aspirated, supercharged, or turbocharged. The engine shall be 2- or 4-stroke-cycle and compression-ignition type. The engine shall be vertical in-line, V- or opposed-piston type, with a solid cast block or individually cast cylinders. The engine shall have a minimum of two cylinders. Opposed-piston type engines shall have not less than four cylinders. Each block shall have a coolant drain port.

2.2.1 Transient Load Capability

Each engine shall be capable of receiving and responding to specified maximum step load changes within the transient loading recovery time.

2.2.2 Speed Sensor

Each engine shall be equipped with an overspeed sensor.

2.3 FUEL SYSTEM

The entire fuel system for each engine-generator set shall conform to the requirements of NFPA 30 and NFPA 37 and contain the following elements.

2.3.1 Pumps

2.3.1.1 Main Pump

Each engine shall be provided with an engine driven pump. The pump shall supply fuel at a minimum rate of 200 percent of the expected fuel consumption at 110 percent of full rated output capacity.

2.3.2 Fuel Filter

A minimum of one full-flow fuel filter shall be provided for each engine. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked. An indicating differential pressure gauge shall be provided across the filter.

2.3.3 Relief/Bypass Valve

A relief/bypass valve shall be provided to regulate pressure in the fuel supply line, return excess fuel to a return line and prevent the build-up of excessive pressure in the fuel system.

2.3.4 Fuel Sensors

Fuel shall be metered to an accuracy of plus or minus 0.1 liter per hour for that fuel which is consumed by the engine only. A pressure sensing device shall be installed on the fuel header at the engine.

2.3.5 Fuel Tank

A dual wall sub-base day tank shall be supplied for the generator set. A dual wall fuel tank shall be supplied for the generator set.

2.3.5.1 Capacity, Standby

Main fuel tank shall have a capacity sufficient to operate the generator set for a minimum of 72 hours at 100 percent standby rated output.

2.3.5.2 Local Fuel Fill

Each local fuel fill port on the fuel tank shall be provided with a screw-on cap, and shall be equipped with an overflow spill box of minimum 7.7 liter capacity.

2.3.5.3 Construction

Each fuel tank shall be double wall construction on the bottom and sides with an inner tank constructed of 4.5 mm steel. Internal baffles on not more than 610 mm centers for truss style support are required. The baffles shall separate the fuel supply and return areas of the tank, and allow for 37.8 liter per minute fuel flow between tank sections. The outer tank (basin) shall be constructed of 4.5 mm steel minimum, supporting a minimum 6 mm thick top plate. A 50.8 mm basin drain with plug shall be provided. The inner tank shall be welded into the basin and sealed weather tight.

Each fuel tank shall be no greater than 762 mm in height. Exposed top fuel tank surfaces shall be adequately prepared to serve as an access platform to the generator set and generator set control panel. Any such surfaces

shall have skid resistant decking. Provide personnel steps with handrail at the control end of the fuel tank.

Fuel pickup and return fittings for connection to the engine generator set shall be provided. Each tank shall have provisions for electrical stub up penetrations by means of a vertical through-tank penetration. The stub up penetration minimum dimensions shall be 457 mm by 508 mm, and shall be located directly below the alternator electrical connection box.

Each fuel tank shall be phosphate cleaned externally, and primed and painted to 0.05 mm DFT for each process.

Each fuel tank shall be capable of supporting the operating engine generator set, and shall be furnished with lifting lugs capable of lifting the entire assembled unit.

2.3.5.4 Indication and Alarm

The main fuel tank shall have a mechanical fuel level gauge and low fuel alarm sending unit set at 30 percent remaining tank capacity. A basin alarm switch shall be provided to indicate inner tank leakage.

2.4 LUBRICATION

Each engine shall have a separate lube-oil system conforming to NFPA 30 and NFPA 37. Each system shall be pressurized by engine-driven pumps. A pressure relief valve shall be provided on the crankcase. The crankcase shall be vented in accordance with the manufacturer's recommendation except that it shall not be vented to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, shall be piped to vent to the outside. The system shall be readily accessible for service such as draining, refilling, etc. Each system shall permit addition of oil and have oil-level indication with the set operating. The system shall utilize an oil cooler as recommended by the engine manufacturer.

2.4.1 Lube-Oil Filter

One full-flow filter shall be provided for each pump. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked. An indicating differential pressure gauge shall be provided across the filter.

2.4.2 Lube-Oil Sensors

Each engine shall be equipped with lube-oil temperature and pressure sensors. Temperature sensors shall provide signals for Pre-High and High Lube-Oil indication and alarms. Pressure sensors shall be located downstream of the filters and provide signals for Pre-Low and Low Lube-Oil indication and alarms.

2.5 COOLING

Each engine shall have its own cooling system. Each system shall operate automatically while its engine is running. The cooling system coolant shall use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified. The maximum temperature rise of the coolant across each engine shall not exceed

that recommended and submitted in paragraph SUBMITTALS.

2.5.1 Coolant Pumps

Coolant pumps shall be the centrifugal type. Each engine shall have an engine-driven primary pump. Secondary pumps shall be electric motor driven and have automatic controllers.

2.5.2 Heat Exchanger

Each heat exchanger shall be of a size and capacity to limit the maximum allowable temperature rise in the coolant across the engine to that recommended and submitted in paragraph SUBMITTALS for the maximum summer outdoor design temperature and site elevation. Each heat exchanger shall be corrosion resistant, suitable for service in ambient conditions of application.

2.5.2.1 Fin-Tube-Type Heat Exchanger (Radiator)

Heat exchanger may be factory coated with corrosive resistant film, provided that correction measures are taken to restore the heat rejection capability of the radiator to the initial design requirement via over sizing, or other compensating methods. Internal surfaces shall be compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Contracting Officer. Heat exchangers shall be pressure type incorporating a pressure valve, vacuum valve and a cap. Caps shall be designed for pressure relief prior to removal. Each heat exchanger and the entire cooling system shall be capable of withstanding a minimum pressure of 48 kPa and shall be protected with a strong grille or screen guard. Each heat exchanger shall have at least two tapped holes; one tapped hole shall be equipped with a drain cock, the rest shall be plugged.

2.5.3 Thermostatic Control Valve

A modulating type, thermostatic control valve shall be provided in the coolant system to maintain the coolant temperature range submitted in paragraph SUBMITTALS.

2.5.4 Ductwork

Ductwork shall be as specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM except that a flexible connection shall be used to connect the duct to the diesel engine radiator. Material for the connection shall be wire-reinforced glass. The connection shall be rendered as airtight as possible.

2.5.5 Temperature Sensors

Each engine shall be equipped with coolant temperature sensors. Temperature sensors shall provide signals for pre-high and high indication and alarms.

2.6 SOUND LIMITATIONS

The limits listed are applicable only as referenced in this specification.

Frequency Band (Hz)	Maximum Acceptable Sound Level (Decibels)	
20-75	87	81
75-150	77	71
150-300	70	64
300-600	64	58
600-1,200	61	55
1,200-2,400	60	54
2,400-4,800	60	54
4,800-10 kHz	62	56

2.7 EXHAUST SYSTEM

The system shall be separate and complete for each engine. Piping shall be supported to minimize vibration. Where a V-type engine is provided, a V-type connector, with necessary flexible sections and hardware, shall connect the engine exhaust outlets.

2.7.1 Flexible Sections and Expansion Joints

A flexible section shall be provided at each engine and an expansion joint at each muffler. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at 538 degrees C. Expansion and flexible elements shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.7.2 Exhaust Muffler

A chamber type exhaust muffler shall be provided. The muffler shall be of welded steel and designed for outside mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer. Outside mufflers shall be zinc coated or painted with high temperature 650 degrees C resisting paint. The muffler and exhaust piping together shall reduce the noise level to less than the maximum acceptable level listed for sound limitations in paragraph SOUND LIMITATIONS, at a distance of 22.9 m from the end of the exhaust piping directly along the path of discharge for horizontal discharged exhausts; or at a radius of 22.9 m from the muffler/discharge piping, at 45 degrees apart in all directions, for vertically discharged exhausts, with the engine-generator set operating at 100 percent of rated output capacity. The muffler shall have a drain valve, nipple, and cap at the low-point of the muffler.

2.7.3 Exhaust Piping

Horizontal sections of exhaust piping shall be sloped downward away from the engine to a drip leg for collection of condensate with drain valve and cap. Changes in direction shall be long radius. Exhaust piping, mufflers and silencers installed inside any building shall be insulated in accordance with paragraph THERMAL INSULATION and covered to protect personnel. Vertical exhaust piping shall be provided with a hinged, gravity-operated, self-closing, rain cover.

2.8 STARTING SYSTEM

2.8.1 Controls

An engine start-stop switch shall be provided with functions including: test, reset, manual-run/start, manual stop, and automatic modes. Start-stop logic shall be provided for adjustable cycle cranking and cooldown operation. The logic shall be arranged for manual starting and fully automatic starting in accordance with paragraph AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION. Electrical starting systems shall be provided with an adjustable cranking limit device to limit cranking periods from 8 seconds up to the maximum duration.

2.8.2 Capacity

The starting system shall be of sufficient capacity, at the maximum outdoor summer temperature specified to crank the engine without damage or overheating. The system shall be capable of providing a minimum of three cranking periods with 8 second intervals between cranks. Each cranking period shall have a maximum duration of 8 seconds.

2.8.3 Electrical

An electrical starting system shall be provided to operate on a 24 -volt dc system utilizing a negative circuit ground. Starting motors shall be in accordance with SAE ARP 892.

2.8.3.1 Battery

A starting battery system shall be provided and shall include the battery, battery rack, intercell connectors, spacers, automatic battery charger with overcurrent protection, metering and relaying. The battery shall be in accordance with SAE J 537. Critical system components (rack, protection, etc.) shall be sized to withstand the seismic acceleration forces of the zone specified in paragraph Engine-Generator Parameter Schedule. The battery shall be lead-acid, with sufficient capacity, at the minimum outdoor and maximum outdoor temperature specified, to provide the specified cranking periods.

2.8.3.2 Battery Charger

A current-limiting battery charger, conforming to UL 1236, shall be provided and shall automatically recharge the batteries. The charger shall be capable of an equalize-charging rate for recharging fully depleted batteries within 8 hours and a floating charge rate for maintaining the batteries at fully charged condition. An ammeter shall be provided to indicate charging rate. A voltmeter shall be provided to indicate charging voltage. A timer shall be provided for the equalize-charging-rate setting.

2.8.4 Starting Aids

2.8.4.1 Glow Plugs

Glow plugs shall be designed to provide sufficient heat for combustion of fuel within the cylinders to guarantee starting at an ambient temperature of minus 32 degrees C.

2.8.5 Exerciser

A programmable, timing device or sequential controller shall be provided to start, operate, and automatically stop the engine-generator set to permit periodic operation for a preset period of time at preset intervals. Intervals shall be adjustable from 1 hour to not less than 168 hours, and factory set at 168 hours. Running periods shall be adjustable from 60 to 360 minutes, including the engine cool-down period, and factory set at 90 minutes. The design of the system exerciser shall include the following provisions:

a. Manual activation switch.

b. Manual reset switch. Reset switch shall terminate the run period and activate control logic to return system loads to the normal or preferred source, and to shut down the engine generator set after the cooldown period.

c. Coordination with the automatic transfer switch controls and logic so that the system loads are returned to the normal or preferred source upon manual reset, and upon loss of engine generator set output voltage, if the normal or preferred source is available.

2.9 SAFETY SYSTEM

Devices, wiring, remote annunciator panels, panels, etc. shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. The safety system shall be provided with a self-test method to verify its operability. Alarm signals shall have manual acknowledgment and reset devices. The alarm signal systems shall reactivate for new signals after acknowledgment is given to any signal. The systems shall be configured so that loss of any monitoring device shall be dealt with as an alarm on that system element.

2.9.1 Audible Signal

The audible alarm signal shall sound at a frequency of 70 Hz at a volume of 75 dB at 3.1 m. The sound shall be continuously activated upon alarm and silenced upon acknowledgment. Signal devices shall be located as shown.

2.9.2 Visual Signal

The visual alarm signal shall be a panel light. The light shall be normally off, activated to be blinking upon alarm. The light shall change to continuously lit upon acknowledgment. If automatic shutdown occurs, the display shall maintain activated status to indicate the cause of failure and shall not be reset until cause of alarm has been cleared and/or restored to normal condition. Shutdown alarms shall be red; all other alarms shall be amber.

2.9.3 Alarms and Action Logic

2.9.3.1 Shutdown

Simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator field and main circuit breakers shall be accomplished.

2.9.3.2 Problem

Activation of the visual signal shall be accomplished.

2.9.4 Alarm Panel

The panel shall be as specified in paragraph PANELS and shall contain the following functions:

	Function/Device	Alarm/Action
a.	Red emergency stop switch)	Shutdown (push button or
b.	Engine overspeed indication	Shutdown (110 percent of rated speed)
c.	High lube-oil temperature indication	Shutdown (Temperature as submitted)
d.	Low lube-oil pressure indication	Shutdown (Pressure as submitted)
e.	High coolant fluid outlet temperature indication	Shutdown (Temperature as submitted)
f.	Pre-Low lube-oil pressure indication	Problem (110 percent of low lube-oil pressure)
g.	Pre-high coolant fluid temperature indication	Problem (5 degrees C lower than coolant-fluid outlet shutdown temperature)
h.	Pre-high lube-oil temperature indication	Problem (5 degrees C before shutdown)
i.	Storage tank low fuel limit indication	Problem (70 percent volume remaining)
j.	Failure to start within the specified time	Problem indication.

2.9.5 Time-Delay on Alarms

For startup of the engine-generator set, time-delay devices shall be installed bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. The lube-oil time-delay device shall return its alarm to normal status after the engine starts. The coolant time-delay device shall return its alarm to normal status 5 minutes after the engine starts.

2.9.6 Remote Alarm Panel

A remote alarm panel shall be 100 percent redundant to the Alarm Panel.

2.10 GOVERNOR

Each engine shall be provided with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100 percent of rated output capacity. The governor shall be configured for safe manual adjustment of the speed/frequency during operation of the engine-generator set, without special tools, from 90 to

110 percent of the rated speed/frequency.

2.10.1 Governor Performance

2.10.1.1 Isochronous Governors

Isochronous governors shall maintain the midpoint of the frequency bandwidth at the same value for steady-state loads over the range of zero to 100 percent of rated output capacity. The governor shall be configured for safe, manual, external adjustment of the droop from zero to 3 percent.

2.10.1.2 Droop Governors

Droop governors shall maintain the midpoint of the frequency bandwidth linearly for steady-state loads over the range of zero to 100 percent of rated output capacity, with 3 percent droop configured for safe, manual, external adjustment of the droop from zero to 5 percent.

2.10.2 Bandwidths

2.10.2.1 Mechanical-Hydraulic

Hydraulic governors shall have centrifugal speed sensing and maintain a frequency bandwidth of plus or minus 0.40 percent, maximum.

2.10.2.2 Electrical

Electrical governors shall have electrical speed sensing and maintain a frequency bandwidth of plus or minus 0.25 percent, maximum.

2.10.2.3 Electro-Hydraulic

Electro-hydraulic governors shall have electrical speed and load sensing with a manually adjustable bandwidth of 0.25 to 3 percent of rated frequency. The bandwidth shall be set at 0.25 percent of rated frequency.

2.11 ENGINE PANEL

The panel shall be as specified in paragraph PANELS and shall contain the following items:

a. Coolant-fluid inlet temperature display.

b. Lubricating-oil pressure indicator.

c. Lubricating-oil inlet temperatures display.

d. Red emergency stop (push-button or switch).

e. Run-time meter.

f. Fuel meter display.

g. Fuel-header-pressure display.

h. Tachometer display.

i. Engine start-stop switch.

j. Start-attempt light indicator.

k. Lubricating-oil prelubricating pump start-stop switch.

l. Pyrometer display with selector switch.

m. Alarm Panel.

2.12 GENERATOR

Each generator shall be of the synchronous type, one or two bearing, conforming to NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine. Generator design shall protect against mechanical, electrical and thermal damage due to vibration, 25 percent overspeeds, or voltages and temperatures at a rated output capacity of 110 percent for prime applications and 100 percent for standby applications. Generator ancillary equipment shall meet the short circuit requirements of NEMA MG 1. Frames shall be the drip-proof type. For two-bearing generators, the maximum voltage drop due to shaft current through the generator bearings at 100 percent output capacity shall be less than 100 mV with sealed-ball or spherical roller bearings and less than 200 mV with sleeve bearings.

2.12.1 Current Balance

At 100 percent rated output capacity, and load impedance equal for each of the 3 phases, the permissible current difference between any 2 phases shall not exceed 2 percent of the largest current on either of the 2 phases.

2.12.2 Voltage Balance

At any balanced load between 75 and 100 percent of rated output capacity, the difference in line-to-neutral voltage among the 3 phases shall not exceed 1 percent of the average line-to-neutral voltage. For a single-phase load condition, consisting of 25 percent load at unity power factor placed between any phase and neutral with no load on the other 2 phases, the maximum simultaneous difference in line-to-neutral voltage between the phases shall not exceed 3 percent of rated line to neutral voltage. The single-phase load requirement shall be valid utilizing normal exciter and regulator control. The interpretation of the 25 percent load for single phase load conditions means 25 percent of rated current at rated phase voltage and unity power factor.

2.12.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at balanced rated output capacity shall not exceed 10 percent. The RMS of all harmonics shall be less than 5.0 percent and that of any one harmonic less than 3.0 percent of the fundamental at rated output capacity.

2.13 EXCITER

The generator exciter shall be of the brushless type. Semiconductor rectifiers shall have a minimum safety factor of 300 percent for peak inverse voltage and forward current ratings for all operating conditions, including 110 percent generator output at 4O degrees C ambient. The exciter and regulator in combination shall maintain generator-output voltage within the limits specified. The exciter shall maintain output

current at the level and duration required to trip the generator breaker (IEEE device 52) under fault conditions.

2.14 VOLTAGE REGULATOR

Each generator shall be provided with a solid-state voltage regulator, separate from the exciter, which maintains the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100 percent of rated output capacity. Regulator shall be configured for safe manual adjustment of the engine-generator voltage output without special tools, during operation, from 90 to 110 percent of the rated voltage. Regulation drift shall not exceed plus or minus 0.5 percent for an ambient temperature change of 20 degrees C.

2.14.1 Steady State Performance

The voltage regulator shall have a maximum droop of 3 percent of rated voltage over a load range from 0 to 100 percent of rated output capacity and automatically maintain the generator output voltage within the specified operational bandwidth.

2.14.2 Regulator Bandwidth

Regulators shall have an operational bandwidth of plus or minus 1 percent of rated voltage.

2.15 GENERATOR ISOLATION AND PROTECTION

Devices necessary for electrical protection and isolation of each engine-generator set and its ancillary equipment shall be provided. The generator circuit breaker (IEEE Device 52) ratings shall be consistent with the generator rated voltage and frequency, with continuous, short circuit withstand, and interrupting current ratings to match the generator capacity. The generator circuit breaker shall be manually operated. A set of surge capacitors, to be mounted at the generator terminals shall be provided. Monitoring and control devices shall be as specified in paragraph GENERATOR PANEL.

2.15.1 Devices

Switches, circuit breakers, switchgear, fuses, relays, and other protective devices shall be as specified in Section 16475 COORDINATED POWER SYSTEM PROTECTION.

2.16 GENERATOR PANEL

The panels shall be as specified in paragraph PANELS and shall provide controls, gauges, meters, and displays to include:

a. Frequency meter, dial type, with a range of 90 to 110 percent of rated frequency. Vibrating-reed type meters shall not be used.

b. Voltmeter, ac, dial type, 3-phase, with 4-position selector switch for the generator output.

c. Ammeter, 3-phase, with 4-position selector switch.

d. Generator field contactor or circuit breaker and discharge resistor, if provided.

e. Voltage regulator control.

2.17 PANELS

Each panel shall be of the type and kind necessary to provide specified functions. Panels shall be mounted on the engine-generator set base by vibration/shock absorbing type mountings. Instruments shall be mounted flush or semiflush. Convenient access to the back of panels shall be provided to facilitate maintenance. Instruments shall be calibrated using recognized industry calibration standards. Each panel shall be provided with a panel identification plate which clearly identifies the panel function. Each instrument and device on the panel shall be provided with a plate which clearly identifies the device and its function as indicated. Switch plates shall clearly identify the switch-position function.

2.17.1 Enclosures

Enclosures shall be designed for the application and environment, conforming to NEMA ICS 6. Locking mechanisms shall be keyed alike.

2.17.2 Electronic

Electronic indicating instruments shall be true RMS indicating instruments, 100 percent solid state, state-of-the-art, microprocessor controlled to provide specified functions. Control, logic, and function devices shall be compatible as a system, sealed, dust and water tight, and shall utilize modular components with metal housings and digital instrumentation. An interface module shall be provided to decode serial link data from the electronic panel and translate alarm, fault and status conditions to set of relay contacts. Instrument accuracy shall be not less than 98 percent for unit mounted devices and 99 percent for control room, panel mounted devices, throughout a temperature range of minus 20 to plus 65 degrees C. Data display shall utilize LED or back lit LCD. Additionally, the display shall provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height shall be 13 mm.

2.17.3 Parameter Display

Continuous indication of the tachometer, lubricating-oil pressure, ac voltmeter, ac ammeter, frequency meter, and safety system parameters shall be provided. A momentary switch shall be specified for other panels.

2.18 AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION

Fully automatic operation shall be provided for the following operations: engine-generator set starting and load transfer upon loss of normal source; retransfer upon restoration of the normal source. Devices shall automatically reset after termination of their function.

2.18.1 Automatic Transfer Switch

Automatic transfer switches shall be in accordance with Section 16410 AUTOMATIC TRANSFER AND BY-PASS/INSOLATION SWITCHES.

2.18.2 Monitoring and Transfer

Devices shall be provided to monitor voltage and frequency for the normal power source and each engine-generator set, and control transfer from the

normal source and retransfer upon restoration of the normal source. Functions, actuation, and time delays shall be as described in Section 16410 AUTOMATIC TRANSFER AND BY-PASS/ISOLATION SWITCHES.

2.19 MANUAL ENGINE-GENERATOR-SET SYSTEM OPERATION

Complete facilities shall be provided for manual starting and testing of each set without load, loading and unloading of each set, and synchronization of each set with an energized bus.

2.20 BASE

The base shall be constructed of steel. The base shall be designed to rigidly support the engine-generator set, ensure permanent alignment of rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment is maintained during shipping and normal operation. The base shall permit skidding in any direction during installation and shall withstand and mitigate the affects of synchronous vibration of the engine and generator. The base shall be provided with suitable holes for anchor bolts and jacking screws for leveling.

2.21 THERMAL INSULATION

Thermal insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.22 PAINTING AND FINISHING

The engine-generator set shall be cleaned, primed and painted in accordance with the manufacturer's standard color and practice.

2.23 FACTORY INSPECTION AND TESTS

Factory inspections and tests shall be performed on each engine-generator set. Each engine and each generator shall be tested by being operated for at least 1 hour at Service Load before being assembled into an engine-generator set. Each engine-generator set shall be run not less than 1 hour at Service Load prior to inspections. Inspections shall be completed and all necessary repairs made, prior to testing. The Contracting Officer may provide one or more representatives to witness inspections and tests.

2.23.1 Factory Inspection

Inspections shall be performed prior to beginning and after completion of testing of the assembled engine-generator set. Inspectors shall look for leaks, looseness, defects in components, proper assembly, etc. and any item found to be in need of correction shall be noted as a necessary repair. The following checklist shall be used for the inspection:

INSPECTION ITEM	GOOD	BAD	NOTES
1. Drive belts			
2. Governor and adjustments			
3. Engine timing mark			
4. Starting motor			
5. Starting aids			
6. Coolant type and concentration			
7. Radiator drains			

8. Block coolant drains
9. Coolant fill level
10. All coolant line connections
11. All coolant hoses
12. Combustion air filter
13. Combustion air silencer
14. Lube oil type
15. Lube oil sump drain
16. Lube-oil filter
17. Lube-oil-level indicator
18. Lube-oil-fill level
19. All lube-oil line connections
20. All lube-oil lines
21. Fuel type and amount
22. All fuel-line connections
23. All fuel lines
24. Fuel filter
25. Coupling and shaft alignment
26. Voltage regulators
27. Battery-charger connections
28. All wiring connections
29. Instrumentation
30. Hazards to personnel
31. Base
32. Nameplates
33. Paint
34. Exhaust-heat recovery unit
35. Switchboard
36. Switchgear

2.23.2 Factory Tests

The following tests shall be performed on each engine-generator set except where the component manufacturer's production line test is noted as acceptable. On engine-generator set tests where the engine and generator are required to be connected and operated together, the load power factor shall be .8 power factor. Tests specified as MIL-STD 705tests may be performed in accordance with the equivalent NEMA MG 1 or IEEE Std 115, or IEEE Std 112 tests. Manufacturer's standard test instruments may be substituted for test instruments specified in MIL-STD 705 tests, as approved by the Contracting Officer. In the following tests where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings.

a. Insulation Resistance for Stator and Exciter Test, per MIL-STD 705 method 301.1: to the performance criteria in NEMA MG 1, 22.51, minimum of 1 megohm per 1000 Volts of rated voltage for armature and field or the recommended polarization index in IEEE Std 43, whichever is more stringent. Generator manufacturer's production line test is acceptable.

b. High Potential Test, per MIL-STD 705 method 302.1: to the performance criteria in MIL-STD 705 or NEMA MG 1, 22.51 and the recommended polarization index in IEEE Std 95. Generator manufacturer's production line test is acceptable.

c. Winding Resistance Test, per IEEE Std 115. Generator manufacturer's production line test is acceptable.

d. Start-and-Stop Test. Record: the starting time; engine manufacturer's after-starting checks and inspections; readings of gauges and instruments; and the time to stop after activation of the manual emergency stop switch. The set shall operate for 5 minutes at rated voltage and frequency and no load prior to activation of the manual emergency stop switch.

e. The engine generator-set shall be operated for at least: 15 minutes at 50 percent of Service Load; 75 percent of Service Load for at least 15 minutes; 100 percent of Service Load at least 30 minutes; and 110 percent of Service Load at least 30 minutes for prime rated sets. Readings of gauges and instruments shall be checked after each load change.

f. Torsion-graphic Test, per MIL-STD 705 method 504.2: to determine that the maximum torsional stress is 34.5 MPa or less. The test shall be performed at a maximum frequency of 61.8 Hz. and a minimum frequency of 58.2 Hz. Alternatively the engine-generator set manufacturer may submit calculations which clearly demonstrate that the maximum torsional stress is not exceeded.

g. Overspeed Vibration Test, per MIL-STD 705 method 505.1a: to the performance criteria in NEMA MG 1, Part 22. The test shall be performed at 110 percent of rated speed for 5 minutes. The vibration shall be measured at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Vibration amplitude and speed shall be recorded at one minute intervals.

h. Overspeed Protective Device Test, per MIL-STD 705 method 505.2a: to the performance criteria specified in paragraph SAFETY SYSTEM. The engine overspeed alarm shall be verified.

i. Phase Sequence Rotation Test, per MIL-STD 705 method 507.1: to the performance criteria shown on the contract drawings. Generator manufacturer's production line test is acceptable.

j. Phase Balance Voltage Test, per MIL-STD 705 method 508.1 or IEEE Std 112: to the performance criteria specified in paragraph GENERATOR.

k. Voltage Waveform (Oscillographic), per MIL-STD 705 method 601.1: to the performance criteria specified in paragraph GENERATOR.

l. Voltage Waveform (Harmonic Analysis) Test, per MIL-STD 705method 601.4: to the performance criteria specified in paragraph GENERATOR. High-speed chart recording instruments capable of recording transient voltage and speed changes shall be used.

m. Current Balance on Stator Winding Test, by measuring the current on each phase of the winding with the generator operating at 100 percent of Service Load, with the load impedance equal for each of the three phases: to the performance criteria specified in paragraph GENERATOR. This test may be performed using any prime mover.

n. Voltage and Frequency Droop Test. Perform and record engine manufacturer's recommended prestarting checks and inspections. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period. For the following steps, verify that the output voltage and frequency return to and stabilize within the specified bandwidth values following each load change. The generator output frequency and line-line and line-neutral voltages shall be recorded following each load change.

1. With the generator operating at 0 percent load, adjust voltage and frequency to rated voltage and frequency. Record the generator output frequency and line-line and line-neutral voltages.

2. Apply and drop load equal to the Maximum Step Load Increase three times in succession.

3. Increase load to 100 percent of Service Load in steps equal to the Maximum Step Load Increase. Adjust the load, voltage and frequency to 100 percent of Service Load and rated voltage and frequency. No further adjustments may be made to any set controls after this step.

4. Reduce the load to no load in one step.

5. Increase load to 100 percent of Service Load in steps equal to the Maximum Step Load Increase. Decrease load to 0 percent of Service Load in steps of 10 percent (operate at each step until voltage and frequency stabilization is achieved).

6. Plot frequency vs. percent of rated load. Plot voltage vs. percent of rated load.

7. Calculate the percent droop for voltage and frequency with the following equations:

$$\text{Voltage droop \%} = \frac{\text{(No-Load Volts) - (Service-Load volts)}}{\text{(Service-Load Volts)}} \times 100$$

$$\text{Frequency droop \%} = \frac{\text{(No-Load Hertz) - (Service-Load hertz)}}{\text{(Service-Load hertz)}} \times 100$$

o. Frequency and Voltage Stability and Transient Response. Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results with high resolution, high speed strip chart recorders and express the results as detailed in MIL-STD 705 method 608.1. Data taken shall include the following:

Ambient temperature (at 15 minute intervals).

Generator output current (before and after load changes).

Generator output voltage (before and after load changes).

Frequency (before and after load changes).

Charts of momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change.

Charts which show the generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

1. Perform and record engine manufacturer's recommended prestarting checks and inspections.

2. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.

3. With the unit at no load, apply the Maximum Step Load Increase.

4. Apply load in steps equal to the Maximum Step Load Increase until the addition of one more step increase will exceed the Service Load.

5. Decrease load to the unit such that addition of the Maximum Step Load Increase will load the unit to 100 percent of Service Load.

6. Apply the Maximum Step Load Increase.

7. Decrease load to zero percent in steps equal to the Maximum Step Load Decrease.

8. Repeat steps 3. through 7.

p. Voltage Unbalance with Unbalanced Load (Line-to-Neutral) Test in accordance with MIL-STD 705 method 620.1a: to the performance criteria specified in paragraph GENERATOR. Prototype test data is acceptable in lieu of the actual test. This test may be performed using any prime mover.

q. For two-bearing generators, perform Shaft Current Test in accordance with MIL-STD 705 method 652.1a.

PART 3 EXECUTION

3.1 GENERAL

Installation shall provide clear space for operation and maintenance in accordance with NFPA 70 and IEEE C2. Installation of pipe, duct, conduit, and ancillary equipment shall be configured to facilitate easy removal and replacement of major components and parts of the engine-generator set.

3.2 PIPING INSTALLATION

3.2.1 General

Piping shall be welded. Connections at valves shall be flanged. Connections at equipment shall be flanged except that connections to the diesel engine may be threaded if the diesel-engine manufacturers standard connection is threaded. Except where otherwise specified, welded flanged fittings shall be utilized to allow for complete dismantling and removal of each piping system from the facility without disconnecting or removing any portion of any other system's equipment or piping. Connections to equipment shall be made with flexible connectors. Pipes extending through the roof shall be properly flashed. Piping shall be installed clear of windows, doors and openings, to permit thermal expansion and contraction without damage to joints or hangers, and shall be installed with a 15 mm drain valve with cap at each low point.

3.2.2 Support

Hangers, inserts, and supports shall be of sufficient size to accommodate any insulation and shall conform to MSS SP-58 and MSS SP-69. Supports shall be spaced not more than 2.1 m on center for pipes 50 mm in diameter or less, not more than 3.6 m on center for pipes larger than 50 mm but smaller than 100 mm in diameter, and not more than 5.2 m on center for pipes larger than 100 mm in diameter. Supports shall be provided at pipe bends or change of direction.

3.2.3 Flanged Joints

Flanges shall be Class 125 type, drilled, and of the proper size and configuration to match the equipment and diesel engine connections. Flanged joints shall be gasketed and made up square and tight.

3.2.4 Cleaning

After fabrication and before assembly, piping interiors shall be manually wiped clean of debris.

3.3 ELECTRICAL INSTALLATION

Electrical installation shall comply with NFPA 70, IEEE C2, and Section 16415 ELECTRICAL WORK, INTERIOR.

3.3.1 Vibration Isolation

Flexible fittings shall be provided for conduit, cable trays, and raceways attached to engine-generator sets.

3.4 FIELD PAINTING

Field painting shall be as specified in Section 09900 PAINTING, GENERAL.

3.5 ONSITE INSPECTION AND TESTS

3.5.1 Test Conditions

3.5.1.1 Data

Measurements shall be made and recorded of all parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, adjustments, replacements, or repairs shall be made and the step repeated until satisfactory results are obtained.

Unless otherwise indicated, data shall be recorded in 15 minute intervals during engine-generator set operation and shall include: readings of all engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as permanent equipment on the engine-generator set.

3.5.1.2 Power Factor

For all engine-generator set operating tests the load power factor shall be .8 power factor.

3.5.1.3 Contractor Supplied Items

The Contractor shall provide equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

3.5.1.4 Instruments

Readings of panel gauges, meters, displays, and instruments provided as permanent equipment shall be verified during test runs, using test instruments of greater precision and accuracy. Test instrument accuracy shall be within the following: current plus or minus 1.5 percent, voltage plus or minus 1.5 percent, real power plus or minus 1.5 percent, reactive power plus or minus 1.5 percent, power factor plus or minus 3 percent, frequency plus or minus 0.5 percent. Test instruments shall be calibrated by a recognized standards laboratory within 30 days prior to testing.

3.5.1.5 Sequence

The sequence of testing shall be as specified in the approved testing plan unless variance is authorized by the Contracting Officer. Field testing shall be performed in the presence of the Contracting Officer. Tests may be scheduled and sequenced in order to optimize run-time periods; however, the following general order of testing shall be followed: Construction Tests; Inspections; Pre-operational Tests; Safety Run Tests; and Performance Tests.

3.5.2 Construction Tests

Individual component and equipment functional tests for fuel piping, coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not provided by the engine-generator set manufacturer shall be performed prior to connection to the engine-generator set.

3.5.2.1 Piping Test

a. Lube-oil and fuel-oil piping shall be flushed with the same type of fluid intended to flow through the piping, until the outflowing fluid has no obvious sediment or emulsion.

b. Piping which is external to the engine-generator set shall be pressure tested with air pressure at 150 percent of the maximum anticipated working pressure, but not less than 1.03 MPa, for a period of 2 hours to prove the piping has no leaks. If piping is to be insulated, the test shall be performed before the insulation is applied.

3.5.2.2 Electrical Equipment Tests

a. Insulation integrity tests shall be performed for cables connecting the generator breaker to the automatic transfer switch in accordance with Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

b. Ground-Resistance Tests shall be performed in accordance with Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

c. Circuit breakers shall be examined and tested in accordance with the manufacturer's published instructions for functional testing.

3.5.3 Inspections

The following inspections shall be performed jointly by the Contracting Officer and the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented by the Contractor and submitted in accordance with paragraph SUBMITTALS. The Contractor shall present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features which cannot be verified visually.

1. Drive belts.	(I)
2. Governor type and features.	(I)
3. Engine timing mark.	(I)
4. Starting motor.	(I)
5. Starting aids.	(I)
6. Coolant type and concentration.	(D)
7. Radiator drains.	(I)
8. Block coolant drains.	(I)
9. Coolant fill level.	(I)
10. Coolant line connections.	(I)
11. Coolant hoses.	(I)
12. Combustion air filter.	(I)
13. Intake air silencer.	(I)
14. Lube oil type.	(D)
15. Lube oil sump drain.	(I)
16. Lube-oil filter.	(I)
17. Lube-oil level indicator.	(I)
18. Lube-oil fill level.	(I)
19. Lube-oil line connections.	(I)
20. Lube-oil lines.	(I)
21. Fuel type.	(D)
22. Fuel-level.	(I)
23. Fuel-line connections.	(I)
24. Fuel lines.	(I)
25. Fuel filter.	(I)
26. Access for maintenance.	(I)
27. Voltage regulator.	(I)
28. Battery-charger connections.	(I)
29. Wiring & terminations.	(I)
30. Instrumentation.	(I)

31. Hazards to personnel. (I)
32. Base. (I)
33. Nameplates. (I)
34. Paint. (I)
35. Exhaust-heat system. (I)
36. Exhaust muffler. (I)
37. Switchboard. (I)
38. Switchgear. (I)
39. Access provided to controls. (I)
40. Enclosure is weather resistant. (I)
41. Engine & generator mounting bolts (application). (I)

3.5.4 Pre-operational Tests

3.5.4.1 Insulation Test

Generator and exciter circuits insulation resistance shall be tested with an insulation tester. Stator readings shall be taken at the circuit breaker, to include generator leads to switchgear. Results of insulation resistance tests shall be recorded. Readings shall be within limits specified by the manufacturer. Mechanical operation, insulation resistance, protective relay calibration and operation, and wiring continuity of switchgear assembly shall be verified. Precautions shall be taken to preclude damaging generator components during test.

3.5.4.2 Engine-Generator Connection Coupling Test

When the generator provided is a two-bearing machine, the engine-generator connection coupling shall be inspected and checked by dial indicator to prove that no misalignment has occurred. The dial indicator shall measure variation in radial positioning and axial clearance between the coupling halves. Readings shall be taken at four points, spaced 90 degrees apart. Solid couplings and pin-type flexible couplings shall be aligned within a total indicator reading of 0.012 to 0.025 mm for both parallel and angular misalignment. For gear-type or grid-type couplings, 0.05 mm will be acceptable.

3.5.5 Safety Run Test

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

c. Activate the manual emergency stop switch and record the time to stop.

d. Remove the high and pre-high lubricating oil temperature sensing elements from the engine and temporarily install a temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

e. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period. Operate the engine-generator set at no

load until the output voltage and frequency stabilize. Monitor the temporarily installed temperature gauges. If either temperature reading exceeds the value required for an alarm condition, activate the manual emergency stop switch.

f. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

g. Remove the high and pre-high coolant temperature sensing elements from the engine and temporarily install a temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

h. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period. Operate the engine generator-set at no load until the output voltage and frequency stabilize.

i. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

j. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

k. Operate the engine generator-set for at least 2 hours at 75 percent of Service Load.

l. Verify proper operation and setpoints of gauges and instruments.

m. Verify proper operation of ancillary equipment.

n. Manually adjust the governor to increase engine speed past the overspeed limit. Record the RPM at which the engine shuts down.

o. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of Service Load.

p. Manually adjust the governor to increase engine speed to within 2 percent of the overspeed trip speed previously determined and operate at that point for 5 minutes. Manually adjust the governor to the rated frequency.

q. Manually fill the day tank to a level above the overfill limit. Record the level at which the overfill alarm sounds. Verify shutdown of the fuel transfer pump. Drain the day tank down below the overfill limit.

r. Shut down the engine. Remove the time-delay low lube oil pressure

alarm bypass and try to start the engine.

s. Attach a manifold to the engine oil system that contains a shutoff valve in series with a connection for the engine's oil pressure sensor followed by an oil pressure gauge ending with a bleed valve. The engine's oil pressure sensor shall be moved from the engine to the manifold and its normal location on the engine temporarily sealed. The manifold shutoff valve shall be open and bleed valve closed.

t. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of Service Load.

u. Close the manifold shutoff valve. Slowly allow the pressure in the manifold to bleed off through the bleed valve while watching the pressure gauge. Record the pressure at which the engine shuts down. Catch oil spillage from the bleed valve in a container. Add the oil from the container back to the engine, remove the manifold, and reinstall the engine's oil pressure sensor on the engine.

v. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 100 percent of Service Load. Record the maximum sound level in each frequency band at a distance of 22.9 m from the end of the exhaust piping directly along the path of discharge for horizontally discharged exhausts, or at a radius of 22.9 m from the engine at 45 degrees apart in all directions for vertically discharged exhausts.

w. Manually drain off fuel slowly from the day tank to empty it to below the low fuel level limit and record the level at which the audible alarm sounds. Add fuel back to the day tank to fill it above low level alarm limits.

x. Manually adjust the governor to speed up the engine to a level beyond the over frequency alarm setpoint and record the frequency when the audible alarm sounds. Manually adjust the governor to slow down the engine to a level below the under frequency alarm setpoint and record the frequency when the audible alarm sounds. Return the speed to the rated value. Shut down the engine-generator set.

3.5.6 Performance Tests

In the following tests, where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings.

3.5.6.1 Engine Load Run Test

Test the engine-generator set and ancillary systems at service load to demonstrate durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. The engine load run test shall be accomplished

principally during daylight hours, with an average ambient temperature of 25 degrees C. Data taken at 15 minute intervals shall include the following:

Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.

Pressure: Lube-oil.

Temperature: Coolant.
Lube-oil.
Exhaust.
Ambient.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Include as a minimum checking coolant fluid, fuel, and lube-oil levels.

b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warmup period.

c. Operate the engine generator-set for 2 hours at 75 percent of Service Load.

e. Increase load to 110 percent of Service Load and operate the engine generator-set for 2 hours.

f. Decrease load to 100 percent of Service Load and operate the engine generator-set for 2 hours or until all temperatures have stabilized.

g. Remove load from the engine-generator set.

3.5.6.2 Voltage and Frequency Droop Test

For the following steps, verify that the output voltage and frequency return to and stabilize within the specified bandwidth values following each load change. Record the generator output frequency and line-line and line-neutral voltages following each load change.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. With the generator operating at 0 percent load, adjust voltage and frequency to rated voltage and frequency.

c. Apply and drop load equal to the Maximum Step Load Increase three times in succession.

d. Increase load to 100 percent of Service Load in steps equal to the Maximum Step Load Increase. Adjust the load, voltage and frequency to 100 percent of Service Load and rated voltage and frequency. No further adjustments may be made to any set controls after this step.

e. Reduce the load to no load in one step.

f. Increase load to 100 percent of Service Load in steps equal to the Maximum Step Load Increase. Decrease load to 0 percent of Service Load in steps of 10 percent (operate at each step until voltage and frequency stabilization is achieved).

g. Plot frequency vs. percent of rated load. Plot voltage vs. percent of rated load.

h. Calculate the percent droop for voltage and frequency with the following equations.

Voltage Droop percentage = ((No-Load Volts)-(Service-Load Volts))/(Service-Load Volts) x 100

Frequency Droop percentage = ((No-Load Hertz)-(Service-Load Hertz))/(Service-Load Hertz) x 100

3.5.6.3 Voltage Regulator Range Test

For the following steps, record the output line-line and line-neutral voltages and frequency after performing each step instruction (after stabilization of voltage and frequency).

a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Apply load in steps no larger than the Maximum Step Load Increase to load the engine-generator set to 100 percent of Service Load. Adjust voltage and frequency to rated voltage and frequency. No further adjustments may be made to any set control for the remainder of this test except the control panel voltage adjust device.

c. Remove all load.

d. While operating at 0 percent of Service Load, adjust the voltage regulator to 110 percent of rated voltage.

e. Increase load from 0 to 100 percent of Service Load.

f. Decrease load from 100 to 0 percent of Service Load.

g. While operating at 0 percent of Service Load, adjust the voltage regulator to the maximum attainable voltage or to a value just prior to actuation of the over-voltage protective device.

h. Increase load from 0 to 100 percent of Service Load.

i. Decrease load from 100 to 0 percent of Service Load.

j. While operating at 0 percent of Service Load, adjust the voltage regulator to 90 percent of rated voltage.

k. Increase load from 0 to 100 percent of Service Load.

l. Adjust the voltage regulator to the minimum attainable value or the value just prior to activation of the undervoltage protection

device.

m. Decrease the load to 0 percent of Service Load.

n. With the data recorded while the voltage regulator setpoint was at 110 percent rated voltage, calculate the percent voltage droop with the following equation.

Voltage Droop percentage = ((No-Load Volts)-(Service-Load Volts))/(Service-Load Volts) x 100

o. Repeat the above calculation for the data recorded for the voltage regulator setpoint of 90 percent rated voltage, and for the maximum and minimum attainable voltage levels.

3.5.6.4 Governor Adjustment Range Test

For the following steps, record the output line-line and line-neutral voltages and frequency after performing each step instruction (after stabilization of voltage and frequency). Operate for approximately two minutes at each step.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Make initial adjustments to the load, voltage and frequency to obtain rated values. No further adjustments may be made to any set control for the remainder of this test except the control panel frequency adjust device.

c. While operating at rated voltage and 0 percent of Service Load, adjust the governor to 90 percent of rated frequency or just above the underfrequency trip setpoint.

d. Increase load to 100 percent of Service Load in steps equal to the maximum step load increase.

e. Decrease load from 100 to 0 percent of Service Load. Adjust the governor control to just below the engine overspeed trip setpoint.

f. Apply 100 percent of Service Load in steps equal to the maximum step load increase and operate for approximately two minutes at each step.

g. With the data recorded while the governor setpoint was at 90 percent rated frequency calculate the percent frequency regulation with the following equation.

Frequency Droop percentage = ((No-Load Hertz)-(Servcie-Load Hertz))/(Service-Loade Hertz) x 100

h. Repeat the above calculation using the data recorded with the governor control at just below the engine overspeed trip setpoint.

3.5.6.5 Frequency and Voltage Stability and Transient Response

Verify that the engine-generator set responds to addition and dropping of

blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results with high resolution, high speed strip chart recorders and express the results as detailed in MIL-STD 705 method 608.1. Data taken shall include the following:

Ambient temperature (at 15 minute intervals).

Generator output current (before and after load changes).

Generator output voltage (before and after load changes).

Frequency (before and after load changes).

Charts of momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change.

Charts which show the generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.

c. With the unit at no load, apply the Maximum Step Load Increase.

d. Apply load in steps equal to the Maximum Step Load Increase until the addition of one more step increase will exceed the Service Load.

e. Decrease load to the unit such that addition of the Maximum Step Load Increase will load the unit to 100 percent of Service Load.

f. Apply the Maximum Step Load Increase.

g. Decrease load to zero percent in steps equal to the Maximum Step Load Decrease.

h. Repeat steps c. through g.

3.5.6.6 Automatic Operation Tests for Stand-Alone Operation

The automatic loading system shall be tested to demonstrate automatic starting, and loading and unloading of each engine-generator set. The loads for this test shall utilize the actual loads to be served, and the loading sequence shall be the indicated sequence. A voltage and frequency stability and transient response test shall be performed for each load change. Data taken shall include the following:

Ambient temperature (at 15 minute intervals).

Generator output current (before and after load changes).

Generator output voltage (before and after load changes).

Generator output frequency (before and after load changes).

Charts of momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change.

Charts which show the generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

a. Initiate loss of the primary power source.

b. Verify starting of the engine generator set and function of the automatic transfer switch. Record the time to start and assume load (voltage and frequency measurements are required on the load terminals of the automatic transfer switch). Verify stabilization of voltage and frequency within specified bandwidths.

c. Verify that the automatic loading system sequences load onto the system as indicated. Verify stabilization of voltage and frequency within specified bandwidths after each load change.

d. Restore the primary power source and monitor transfer from the alternate power source to the primary power source. Verify operation and time delay settings for the automatic transfer switch. Verify stabilization of voltage and frequency of the primary system. Verify stabilization of the engine-generator set voltage and frequency at no load.

e. Monitor the cool-down period for the engine. Record the ambient temperature, coolant temperature, and time from system transfer until engine shutdown.

f. Verify resetting of controls to normal.

3.5.7 Final Inspection

a. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Any corrective action shall be verified for effectiveness by running the engine for 8 hours at Service Load, then re-examining the oil and filter.

b. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.

c. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

d. Increase the load in steps no greater than the Maximum Step Load Increase to 100 percent of Service Load, and operate the engine-generator set for at least 30 minutes.

e. Measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.

f. Remove load and shut down the engine-generator set after the recommended cool down period.

3.6 FRAMED INSTRUCTIONS

Two sets of instructions shall be typed and framed under weatherproof laminated plastic, and posted side-by-side where directed before acceptance. First set of instructions shall include wiring and control diagrams and a complete layout of the system. Second set of instructions shall include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches).

3.7 MANUFACTURER'S FIELD SERVICE

3.7.1 Onsite Training

The Contractor shall conduct training course for operating staff as designated by the Contracting Officer. The training period shall consist of a total 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. The course instructions shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate routine maintenance operations such as oil change, oil filter change, air filter change, etc. Two copies of a VHS format video tape of the entire training session shall be submitted.

3.7.2 Field Engineer

The engine-generator set manufacturer or assembler shall furnish a qualified field engineer to supervise the complete installation of the engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment.

3.8 ACCEPTANCE

Final acceptance of the engine-generator set will not be given until the contractor has successfully completed all tests and all defects in installation material or operation have been corrected.

-- End of Section --

SECTION 16710

PREMISES DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA ANSI/TIA/EIA-568-A	(1995) Commercial Building Telecommunications Cabling Standard
EIA ANSI/TIA/EIA-606	(1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
EIA ANSI/TIA/EIA-607	(1994) Commercial Building Grounding and Bonding Requirements for Telecommunications
EIA TSB 67	(1995) Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-80-576	(1994) Communications Wire and Cable for Wiring of Premises

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

1.2 SYSTEM DESCRIPTION

The premises distribution system shall consist of inside-plant horizontal, riser, and backbone cables and connecting hardware to transport telephone and data (including LAN) signals between equipment items in a building.

1.3 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 0 to 60 degrees C and in the range of 0 to 95 percent relative humidity, noncondensing.

1.4 QUALIFICATIONS

1.4.1 Minimum Contractor Qualifications

All work under this section shall be performed by and all equipment shall be furnished and installed by a certified Telecommunications Contractor, hereafter referred to as the Contractor. With the exception of furnishing

and installing conduit, electrical boxes, and pullwires, this work shall not be done by the Electrical Contractor. The Contractor shall have the following qualifications in Telecommunications Systems installation:

a. Contractor shall have a minimum of 3 years experience in the application, installation and testing of the specified systems and equipment.

b. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products. General electrical trade staff (electricians) shall not be used for the installation of the premises distribution system cables and associated hardware.

c. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

1.4.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of 3 years experience in producing the types of systems and equipment specified.

1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Spare Parts; FIO.

Lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of detail drawings, not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

SD-04 Drawings

Premises Distribution System; GA.

Detail drawings including a complete list of equipment and material. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings of telecommunications closet walls, outlet face plate details for all outlet configurations, sizes and types of all cables, conduits, and cable trays. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.

Record Drawings; GA.

Record drawings for the installed wiring system infrastructure per EIA ANSI/TIA/EIA-606. The drawings shall show the location of all cable terminations and location and routing of all backbone and horizontal cables. The identifier for each termination and cable shall appear on the drawings.

SD-06 Instructions

Manufacturer's Recommendations; GA.

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, prior to installation shall be provided. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

SD-08 Statements

Test Plan; GA.

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Qualifications; GA.

The qualifications of the Manufacturer, Contractor, and the Installer to perform the work specified herein. This shall include proof of the minimum qualifications specified herein.

SD-09 Reports

Test Reports; GA.

Test reports in booklet form with witness signatures verifying execution of tests. Test results will also be provided on 89 mm diskettes in Microsoft Word format. Reports shall show the field tests performed to verify compliance with the specified performance criteria. Test reports shall include record of the physical parameters verified during testing. Test reports shall be submitted within 10 working days after completion of testing.

SD-13 Certificates

Premises Distribution System; GA.

Written certification that the premises distribution system complies with the EIA ANSI/TIA/EIA-568-A standards.

Materials and Equipment; GA.

Where materials or equipment are specified to conform, be constructed or tested to meet specific requirements, certification that the items provided

conform to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

Installers; GA.

The Contractor shall submit certification that all the installers are factory certified to install and test the provided products.

SD-18 Records

Record Keeping and Documentation; GA.

Documentation on cables and termination hardware in accordance with EIA ANSI/TIA/EIA-606.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust or other contaminants.

1.7 OPERATION AND MAINTENANCE MANUALS

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

1.8 RECORD KEEPING AND DOCUMENTATION

1.8.1 Cables

A record of all installed cable shall be provided showing terminating points and cable test. A licensed copy of the cable management software including documentation, shall be provided. Include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

2.2 UNSHIELDED TWISTED PAIR CABLE SYSTEM

2.2.1 Cable Insulation

For each individual Category 5 cable, the insulation, material used on each

pair shall be exactly the same in all physical, electrical, and chemical respects. The use of Teflon insulated, plenum rated Category 5 cable is acceptable for both plenum and non-plenum applications. If Teflon insulated plenum rated cable is used by the Contractor, it shall be Type 4x0, where all four pairs are Teflon insulated. Type 3x1 and 2x2 are not acceptable.

2.2.2 Riser Cable

Riser cable shall meet the requirements of ICEA S-80-576 and EIA ANSI/TIA/EIA-568-A for Category 5 100-ohm unshielded twisted pair cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG. Cable shall be rated CMR or CMP per NFPA 70.

2.2.3 Horizontal Cable

Horizontal cable shall meet the requirements of EIA ANSI/TIA/EIA-568-A for Category 5 horizontal cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG. Cable shall be rated CMG or CMP per NFPA 70.

2.2.4 Connecting Hardware

Connecting and cross-connecting hardware shall be the same category as the cable it serves. Hardware shall be in accordance with and EIA ANSI/TIA/EIA-568-A.

2.2.4.1 Telecommunications Outlets

Wall and desk outlet plates shall come equipped with two modular jacks, with the top or left jack labeled "voice" [AM#0001] (RJ-11) and the bottom or right jack labeled "data" [AM#0001] (RJ-45). Modular jacks shall be [AM#0001] _____ the same category as the cable they terminate and shall meet the requirements of EIA ANSI/TIA/EIA-568-A. Modular jack pin/pair configuration shall be T568A per EIA ANSI/TIA/EIA-568-A. Modular jacks shall be unkeyed. Faceplates shall be provided and shall be ivory in color, impact resistant plastic. Outlet assemblies used in the premises distribution system shall consist of modular jacks assembled into both simplex and duplex outlet assemblies in single or double gang covers as indicated on the drawings. The modular jacks shall conform to the requirements of EIA ANSI/TIA/EIA-568-A, Category 5.

2.2.4.2 Terminal Blocks

Terminal blocks shall be wall mounted wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings. Blocks shall be type 110 which meet the requirements of EIA ANSI/TIA/EIA-568-A for category 5. Blocks shall be mounted on standoffs and shall include cable management hardware. Insulation displacement connectors shall terminate 22 or 24 gauge solid copper wire as a minimum, and shall be connected in pairs so that horizontal cable and connected jumper wires are on separate connected terminals.

2.3 EQUIPMENT MOUNTING BACKBOARD

Plywood backboards shall be provided, sized as shown, painted with white or

light colored paint.

2.4 TELECOMMUNICATIONS OUTLET BOXES

Electrical boxes for telecommunication outlets shall be 117 mm square by 53 mm deep with minimum 9 mm deep single or two gang plaster ring as shown. Provide a minimum 25 mm conduit.

PART 3 EXECUTION

3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided. Components shall be labeled at both connection points, outlet port and punchdown blocks. Penetrations in fire-rated construction shall be firestopped in accordance with Section 07840 FIRESTOPPING. Conduits, outlets and raceways shall be installed in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Wiring shall be installed in accordance with EIA ANSI/TIA/EIA-568-A and as specified in Section 16415 ELECTRICAL WORK, INTERIOR. Wiring, and terminal blocks and outlets shall be marked in accordance at both connection points, punchdown block and outlet port. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with ac power cables. Cables not installed in conduit or wireways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

3.1.1 Horizontal Distribution Cable

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 300 mm shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered. In raised floor areas, cable shall be installed after the flooring system has been installed. Cable 1.8 meters long shall be neatly coiled not less than 300 mm in diameter below each feed point in raised floor areas.

3.1.2 Riser and Backbone Cable

Vertical cable support intervals shall be in accordance with manufacturer's recommendations. Cable bend radius shall not be less than ten times the outside diameter of the cable during installation and once installed. Maximum tensile strength rating of the cable shall not be exceeded. Cable shall not be spliced.

3.1.3 Telecommunications Outlets

3.1.3.1 Faceplates

As a minimum each jack shall be labeled as to its function and a unique number to identify cable link.

3.1.3.2 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 150 mm of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturers bend radius for each type of cable shall not be exceeded.

3.1.3.3 Pull Cords

Pull cords shall be installed in all conduit serving telecommunications outlets which do not initially have fiber optic cable installed.

3.1.4 Terminal Blocks

Terminal blocks shall be mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Industry standard wire routing guides shall be utilized.

3.2 TERMINATION

Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles. Manufacturer's minimum bending radius shall not be exceeded. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.

3.2.1 Unshielded Twisted Pair Cable

Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels. No cable shall be unterminated or contain unterminated elements. Pairs shall remain twisted together to within the proper distance from the termination as specified in EIA ANSI/TIA/EIA-568-A. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket.

3.3 GROUNDING

Signal distribution system ground shall be installed in the telecommunications entrance facility and in each telecommunications closet in accordance with EIA ANSI/TIA/EIA-607 and Section 16415 ELECTRICAL WORK, INTERIOR. Equipment racks shall be connected to the electrical safety ground.

3.4 ADDITIONAL MATERIALS

The Contractor shall provide the following additional materials required for facility startup.

a. 10 of each type outlet.

b. 10 of each type cover plate.

c. 1 of each type terminal block for each telecommunications closet.

d. 1 Set of any and all special tools required to establish a cross connect and to change and/or maintain a terminal block.

3.5 ADMINISTRATION AND LABELING

3.5.1 Labeling

3.5.1.1 Labels

All labels shall be in accordance with EIA ANSI/TIA/EIA-606.

3.5.1.2 Cable

All cables will be labeled using color labels on both ends with alphabetical and numerical identifiers.

3.6 TESTING

Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.

3.6.1 Unshielded Twisted Pair Tests

All metallic cable pairs shall be tested for proper identification and continuity. All opens, shorts, crosses, grounds, and reversals shall be corrected. Correct color coding and termination of each pair shall be verified in the communications closet and at the outlet. Horizontal wiring shall be tested from and including the termination device in the communications closet to and including the modular jack in each room. Backbone wiring shall be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective communications closets. These test shall be completed and all errors corrected before any other tests are started.

3.6.2 Category 5 Circuits

All category 5 circuits shall be tested using a test set that meets the Class II accuracy requirements of EIA TSB 67 standard. Testing shall use the Basic Link Test procedure of EIA TSB 67. Cables which contain failed circuits shall be replaced and retested to verify the standard is met.

-- End of Section --